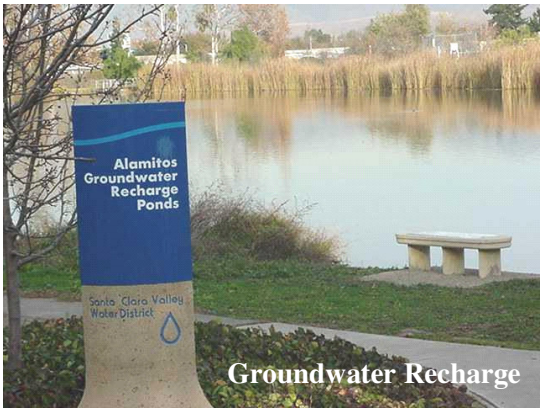
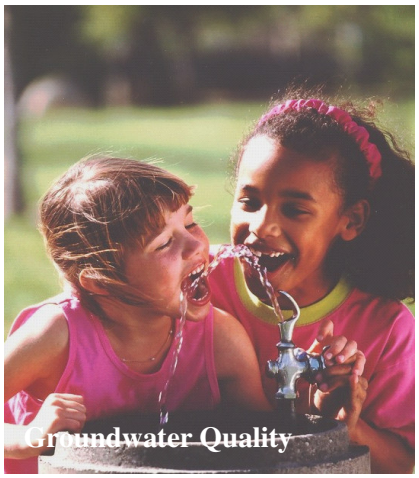
Groundwater Conditions
2001



Groundwater Recharge


Groundwater Quality


Monitoring for Land Subsidence


Groundwater Production

July 2002

Santa Clara Valley Water District

SANTA CLARA VALLEY WATER DISTRICT

Groundwater Conditions 2001

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Table of Contents

EXECUTIVE SUMMARY 1

1.0 INTRODUCTION 4

1.1 Background 4

1.2 Report Contents 5

2.0 GROUNDWATER SUPPLY MANAGEMENT 7

2.1 Santa Clara County Groundwater Subbasins 7

2.2 Groundwater Production 8

2.3 Groundwater Recharge 8
2.3.1 Natural Recharge 8
2.3.2 Artificial Recharge 9

3.0 GROUNDWATER ELEVATION MONITORING 16

3.1 Santa Clara Valley Subbasin 16

3.2 Coyote Subbasin 17

3.3 Llagas Subbasin 17

3.4 Change in Storage 18
3.4.1 North County 18
3.4.2 South County 18

4.0 LAND SUBSIDENCE MONITORING 29

4.1 Extensometers 29

4.2 Subsidence Index Wells 30

4.3 Level Circuit 30

5.0 GROUNDWATER QUALITY 35

5.1 Inorganic Water Quality 35
5.1.1 Mineral Characteristics 36
5.1.2 Total Dissolved Solids 37
5.1.3 Hardness 37
5.1.4 Manganese 37
5.1.5 Iron 38
5.1.6 Chloride 38
5.1.7 Boron 39
5.1.8 Fluoride 39
5.1.9 Turbidity 39
5.1.10 Other Inorganic Constituents 39

5.2 Nitrate *39*
5.2.1 Nitrate Monitoring 40
5.2.2 Nitrate Exposure 41
5.2.3 Nitrate Loading 41

5.3 Volatile Organic Chemicals *41*
5.3.1 Solvents and Toxics Liaison Program 42
5.3.2 Leaking Underground Storage Tank Oversight Program 43

5.4 Synthetic Organic Chemicals *43*

5.5 Radiological Constituents *43*

5.6 Groundwater Quality Summary *44*

6.0 RELATED GROUNDWATER PROJECTS **58**

6.1 Improving the Groundwater Monitoring Network *58*
6.1.1 Depth-Discrete Monitoring Wells 58
6.1.2 Monitoring Network Integration 58

6.2 Improving Groundwater Modeling *58*

6.3 Forecasting Groundwater Conditions for 2002 *59*

6.4 Groundwater Management Plan Update *59*

7.0 NEW GROUNDWATER LEGISLATION AND REGULATIONS **64**

7.1 Groundwater Legislation *64*

7.2 New Regulations *66*
7.2.1 Arsenic 66
7.2.2 Consumer Confidence Reports 66
7.2.3 Unregulated Chemicals Requiring Monitoring 66

8.0 SUMMARY **69**

8.1 Groundwater Use and Recharge *69*

8.2 Groundwater Elevation Monitoring Summary *69*

8.3 Land Subsidence Monitoring Summary *70*

8.4 Groundwater Quality Monitoring Summary *70*

8.5 Future Work *71*

REFERENCES **72**

Tables

Table		Page
2-1	Groundwater Production Summary	11
4-1	Predictions Relating Effective Stress and Subsidence (PRESS) Model Index Well Summary for 2001	32
5-1	Groundwater Constituents Sampled in 2001	45
5-2	Typical Concentration Ranges for Common Inorganic Constituents	46-47
5-3	Volatile Organic Chemical (VOC) Detections	48
5-4	California Aquifer Susceptibility (CAS) Assessment Results Summary	49
5-5	Summary of Active Solvent and Toxics Cases	50
7-1	Unregulated Chemicals Requiring Monitoring	68

Figures

Figure		Page
1-1	Location of Santa Clara County	6
2-1	Santa Clara County Groundwater Subbasins	12
2-2	Total Annual Rainfall at San Jose Station (Rainfall Year)	13
2-3	Accumulated Annual Departure from 127-Year Average Rainfall at San Jose	14
2-4	District In-Stream and Off-Stream Recharge Facilities	15
3-1	Groundwater Elevation Monitoring Wells	19
3-2	Hydrograph for the Santa Clara Valley Subbasin Index Well	20
3-3	North County Groundwater Elevation Contour Map Spring 2001	21
3-4	North County Groundwater Elevation Contour Map Fall 2001	22
3-5	Hydrograph for the Coyote Subbasin Index Wells	23
3-6	South County Groundwater Elevation Contour Map Spring 2001	24
3-7	South County Groundwater Elevation Contour Map Fall 2001	25
3-8	Hydrograph for the Llagas Subbasin Index Well	26
3-9	Annual Change in Storage for the Santa Clara Valley Subbasin since 1988	27
3-10	Annual Change in Storage for the Coyote and Llagas Subbasins since 1988	28
4-1	Subsidence Monitoring Locations	33
4-2	Stress/Deformation Data from San Jose Extensometer	34
5-1	Location of Wells Sampled for Groundwater Quality	51
5-2	Mineral Character of Principal Aquifer Zones in North County	52
5-3	Mineral Character of Principal Aquifer Zones in South County	53
5-4	Extent of Saltwater Intrusion in Upper Aquifer Zone	54
5-5	Nitrate Concentrations in Principal Aquifer Zone	55
5-6	California Aquifer Susceptibility Assessment Project Sampling Results	56
5-7	Groundwater Contamination Plumes	57
6-1	Depth-Discrete Groundwater Monitoring Wells	61
6-2	Coyote Creek Outdoor Classroom (CCOC) Idealized Well Construction and Lithologic Log (Preliminary)	62
6-3	Coyote Creek Outdoor Classroom (CCOC) Site Depth-Specific Groundwater Elevations	63

Executive Summary

The Santa Clara Valley Water District (District) has managed the groundwater basin in Santa Clara County (county) since the early 1930s and is nationally recognized as a leader in groundwater management. The mission of the District is a healthy, safe, and enhanced quality of living in Santa Clara County through the comprehensive management of water resources in a practical, cost-effective, and environmentally-sensitive manner. Effective management of groundwater resources is an essential part of the District's water resource management mission, as the groundwater basin provides nearly half of the county's overall water supply. The District has implemented numerous groundwater management programs and activities to manage the basin and to ensure groundwater resources are sustained and protected both now and in the future. These programs and activities include:

- Groundwater supply management programs that replenish the groundwater basin, sustain the basin's water supplies, help to mitigate groundwater overdraft, and sustain storage reserves for use during dry periods

- Groundwater quality management programs that identify and evaluate threats to groundwater quality and prevent or mitigate contamination associated with those threats

- Groundwater monitoring programs that provide data to assist the District in evaluating and managing the groundwater basin

The collection and analysis of groundwater monitoring data is essential to understanding current groundwater conditions and evaluating whether the District is meeting Board Ends Policies 2.1.5 ("The groundwater basins are aggressively protected from contamination and the threat of contamination") and 2.2.2.3 ("Groundwater supplies are sustained"). Monitoring data provides information on groundwater elevation, groundwater quality, and land subsidence. It is also used as input to the Santa Clara Valley Subbasin groundwater flow model. In addition to providing data on current conditions, groundwater monitoring data is used for predictive analyses to determine water supply conditions under a variety of groundwater management strategies.

This purpose of this 2001 Groundwater Conditions Report is to describe and document conditions within the county's three groundwater subbasins for calendar year 2001. The report summarizes monitoring performed in 2001 and presents results and analyses.

Groundwater Use and Recharge

Approximately 169,300 acre-feet of groundwater was extracted for beneficial use in 2001; this accounts for 44 percent of the total 382,500 acre-feet of water used in Santa Clara County. Approximately 115,400 acre-feet of groundwater was withdrawn from the Santa Clara Valley Subbasin; this includes approximately 114,600 acre-feet for municipal and industrial (M&I) uses, with about 800 acre-feet used for agriculture. Approximately 53,900 acre-feet of groundwater was extracted from the Coyote and Llagas Subbasins in 2001, with approximately 25,400 acre-feet used for M&I uses and 28,500 acre-feet for agriculture.

To balance groundwater extraction, the District conducts artificial recharge operations along water supply facilities, including streams and off-stream ponds. By releasing local and imported waters from local reservoirs or the distribution system, the District significantly enhances the recharge within these facilities. Through artificial recharge operations, approximately 129,100 acre-feet of water recharged the groundwater subbasins through water supply recharge facilities in 2001. Approximately 90,700 acre-feet

of water recharged the Santa Clara Valley Subbasin through artificial recharge operations; this includes 40,700 acre-feet through off-stream ponds and 50,000 acre-feet through the in-stream recharge program. Approximately 38,400 acre-feet of water recharged the Coyote and Llagas Subbasins through artificial recharge operations, including 8,500 acre-feet through off-stream ponds and 29,900 acre-feet through in-stream recharge.

The withdrawals and replenishment summarized above, combined with natural recharge occurring from rainfall and other sources, resulted in the following net change in storage. Storage in the Santa Clara Valley Subbasin increased by approximately 12,500 acre-feet in 2001. In South County, there was a net decrease in the storage of the Coyote and Llagas Subbasins, of approximately 300 acre-feet and 21,000 acre-feet, respectively.

Groundwater Elevation Monitoring Summary

In general, groundwater elevations throughout the county were quite high in 2001, due to a near-normal rainfall year and active groundwater recharge by the District. Current groundwater elevations in the Santa Clara Valley Subbasin index well are near historic highs and are over 200 feet above the minimum groundwater levels recorded since 1915. Additionally, the minimum 2001 groundwater elevation recorded in the fall is approximately 70 feet above the subsidence threshold[1], which is one of the District's performance measures to ensure "Groundwater supplies are sustained" in accordance with Board Ends Policy. While groundwater elevations in the Llagas Subbasin index well remain above the performance measure target elevation[2], groundwater elevations have been declining for the last several years. Overall, 2001 data indicate that the District is exceeding the performance measures established to ensure "Groundwater supplies are sustained."

Land Subsidence Monitoring Summary

As a result of significant historical land subsidence in the North County, the District monitors land subsidence throughout the Santa Clara Valley Subbasin. Monitoring at two extensometers, eight subsidence index wells, and 147 benchmarks in 2001 indicates that any residual subsidence that is occurring is within the tolerable range established by the District. Monitoring at benchmark P7 indicates that the District exceeds the related performance measure designed to ensure "Groundwater supplies are sustained." In general, monitoring data from 2001 indicates that land subsidence in the Santa Clara Valley Subbasin is minimized by the District's proactive groundwater management activities.

Groundwater Quality Monitoring Summary

Overall groundwater quality in Santa Clara County is very good and water quality objectives are achieved in almost all wells. The most significant exception is nitrate, which continues to be a concern in the Llagas and Coyote Subbasins. The nitrate drinking water standard was exceeded in 40 wells. Some of these are upper aquifer zone monitoring wells and others are agricultural supply wells. However, the drinking water standard for nitrate was exceeded in 22 wells whose primary use is municipal or domestic supply, necessitating blending or treatment prior to delivery to customers.

---

[1] Due to significant land subsidence occurring historically in North County, the District established subsidence thresholds, or groundwater elevations below which subsidence will reoccur, at 10 locations throughout the Santa Clara Valley Subbasin. The groundwater basin is managed to maintain groundwater elevations above these thresholds.

[2] No subsidence thresholds have been established for the confined zone in the Llagas Subbasin. However, at this time the District is committed to maintaining groundwater elevations at the Llagas index well above the value of 192.3 feet which was recorded in 1987, the year in which the District assumed management of South County from the Gavilan Water District.

Drinking water standards for other inorganic constituents were exceeded in 20 wells. However, all these exceedences were for naturally occurring constituents, and all but one of the exceedences was for a secondary drinking water standard. Secondary standards are based on protecting consumers from adverse tastes, odors, or appearance and such exceedences do not pose a health risk. One well contained fluoride concentrations in excess of the primary, or health-based, drinking water standard. The agricultural water quality objective for boron was exceeded in 15 wells, but none of those wells is used for agricultural supply.

MTBE was detected just above the secondary drinking water standard of 5 ug/L in two monitoring wells. However, these wells are screened in the upper aquifer zone, rather than in the deeper, primary water supply aquifer. There were no detections of MTBE above the primary drinking water standard.

The drinking water standard for gross alpha particle activity, an indicator of natural radioactivity, was exceeded in one well. However, the average measurement of four consecutive quarters, on which compliance is based, was well below the standard.

District Board Ends Policy directs staff to ensure "The groundwater basins are aggressively protected from contamination and the threat of contamination." The Chief Executive Officer's interpretation of this policy is that drinking water standards for anthropogenic constituents should not be exceeded in water supply wells. The data summarized in this report shows that, for the most part, groundwater management programs achieve the desired end. The nitrate standard was the only drinking water standard for an anthropogenic constituent that was exceeded in drinking water supply wells and it was exceeded in a very small percentage of wells. The District continues to implement a comprehensive nitrate management program to monitor nitrate occurrence, reduce consumer exposure to nitrate in drinking water, and reduce nitrate loading throughout the basin. The goal of the nitrate management program is to reduce nitrate concentrations in groundwater so that all wells meet the drinking water standard for nitrate.

1.0 Introduction

The Santa Clara Valley Water District (District) has managed the groundwater basin in Santa Clara County (Figure 1-1) since the early 1930s and is nationally recognized as a leader in groundwater management. The mission of the District is a healthy, safe, and enhanced quality of living in Santa Clara County through the comprehensive management of water resources in a practical, cost-effective, and environmentally-sensitive manner. Effective management of groundwater resources is an essential part of the District's water resource mission, as the groundwater basin provides nearly half of the county's overall water supply. The District has implemented numerous groundwater management programs and activities to ensure groundwater resources are sustained and protected both now and in the future.

1.1 Background

Since the 1850s, groundwater has been an important component of water supply in Santa Clara County. Historical overpumping of the groundwater basin and significant land subsidence in the northern portion of the county led to the formation of the District as the county's groundwater management agency in 1929. Increased populations, increased demands on the groundwater basin, and continued land subsidence led to the construction of ten local storage reservoirs with a combined capacity of 169,000 acre-feet, the importation of surface water, and the construction of three water treatment plants. Today, the District conjunctively manages groundwater and surface water to provide a reliable water supply for the county's 1.7 million residents.

Since its creation by the State legislature, the District has worked to minimize subsidence and protect the groundwater resources of the county in accordance with the District Act (California Water Code Appendix, Chapter 60). As stated in the District Act, the District's objectives related to groundwater management are to recharge the groundwater basin, conserve water, increase water supply, and to prevent waste or diminution of the District's water supply.

District programs designed to sustain and protect groundwater resources include:

- Groundwater supply management programs that replenish the groundwater basin, sustain the basin's water supplies, help to mitigate groundwater overdraft, and sustain storage reserves for use during dry periods

- Groundwater quality management programs that identify and evaluate threats to groundwater quality and prevent or mitigate contamination associated with those threats

- Groundwater monitoring programs that provide data to assist the District in evaluating groundwater conditions and managing the groundwater basin

In 1999, the District Board of Directors established Ends Policies that direct the Chief Executive Officer to achieve specific results or benefits. The following Ends Policies are related to groundwater:

2.1.2. The water supply is reliable to meet current demands.
2.1.3. The water supply is reliable to meet future demands as identified in the District's Integrated Water Resource Plan (IWRP) process.
2.1.4. There are a variety of water supply sources.
2.1.5. The groundwater basins are aggressively protected from contamination and the threat of contamination.

2.1.6. Water recycling is expanded within Santa Clara County in partnership with the community, consistent with the District's Integrated Water Resource Plan (IWRP), reflecting its comparative cost assessments and other Board policies.

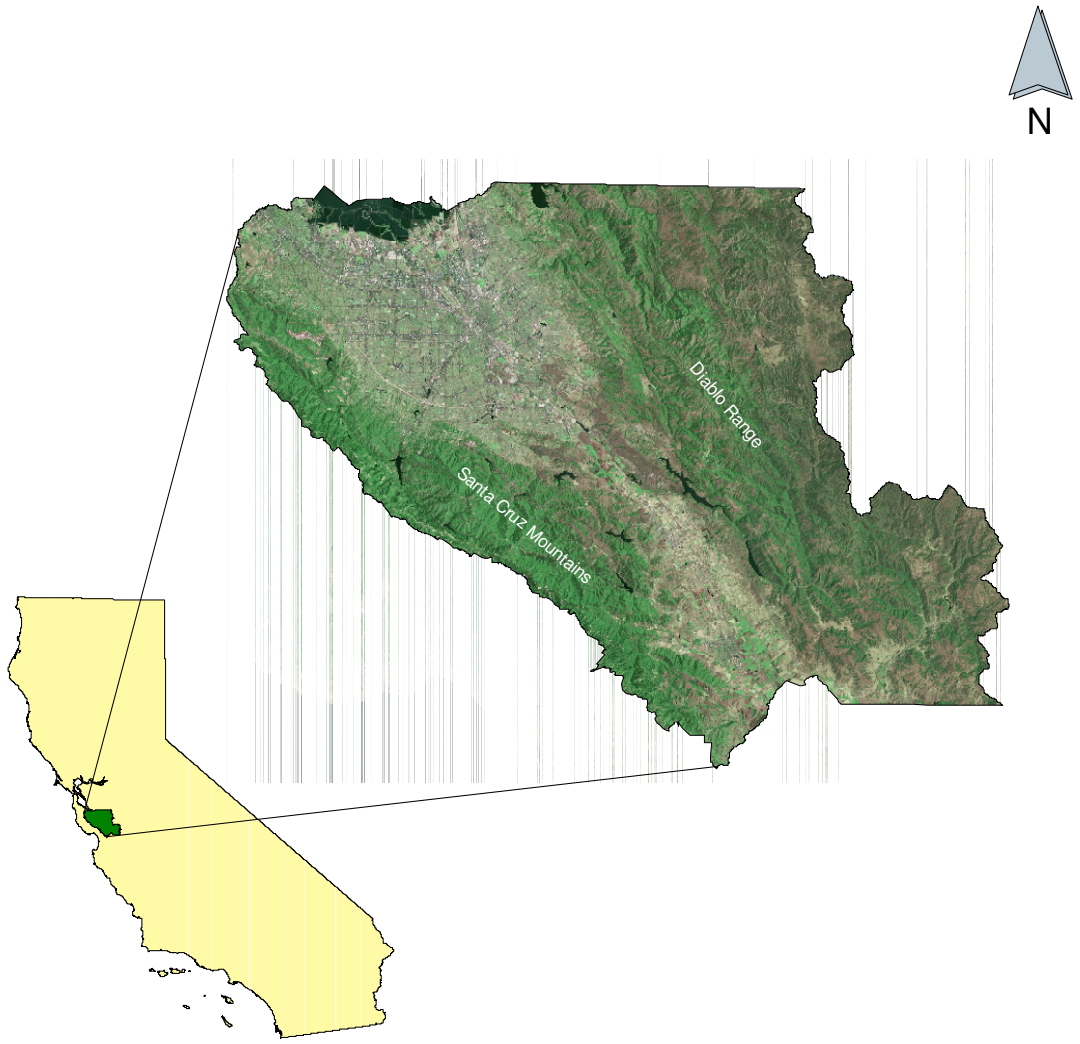
2.2.2.3. Groundwater supplies are sustained.

The District ensures that these ends are met through proactive water supply management activities and planning. The collection and analysis of groundwater monitoring data is essential to understanding current groundwater conditions and to ensuring that Ends Policies 2.1.5 and 2.2.2.3 are met both now and in the future. Monitoring data provides information on groundwater elevation, groundwater quality and land subsidence. In addition to providing data on current conditions, groundwater monitoring data is used for predictive analyses using the groundwater flow model to determine water supply conditions under a variety of groundwater management strategies.

1.2 Report Contents

Section 26.5 of the District Act directs the District to prepare an annual report summarizing the District's activities in the protection and augmentation of water supplies. This requirement is currently being fulfilled through the annual preparation of the Water Utility Enterprise Report. The purpose of this 2001 Annual Groundwater Conditions Report is to provide additional in-depth information to describe and document conditions within the county's three groundwater subbasins for calendar year 2001. The report documents groundwater supply and use in 2001, and summarizes results from District programs to monitor groundwater elevation, land subsidence, and groundwater quality. A complete description of individual monitoring programs can be found in the District's Groundwater Management Plan of July 2001, which is available on the District's website at http://www.valleywater.org. This Groundwater Conditions Report also summarizes new groundwater projects and studies, and provides information on new groundwater legislation and regulations affecting Santa Clara County.

Location of Santa Clara County



Santa Clara Valley Water District

Figure 1-1

2.0 Groundwater Supply Management

As the water resource management agency for Santa Clara County, the District provides a reliable supply of high-quality water to 13 private and public water retailers and to private well owners, serving more than 1.7 million residents in the county. In average years, the District imports approximately 60 percent of the county's water supplies from the State Water Project (SWP), Federal Central Valley Project (CVP), and City and County of San Francisco's managed supplies through the Hetch-Hetchy Project. The remainder of water supply demands are met by the groundwater subbasins and local surface water. The District is currently expanding the role of recycled water for irrigation and non-potable uses in accordance with Board Ends Policy; approximately 8,000 acre-feet of recycled water was delivered in 2001. To provide reliability in future dry years, the District banks water in groundwater storage outside of the county at the Semitropic Water Storage District in Kern County and participates in an imported water exchange program with San Benito County.

The District operates and maintains a countywide conservation and distribution system to convey raw water to groundwater recharge facilities and treatment plants, and to convey treated water for wholesale to retailers. This water conservation and distribution system includes local reservoirs designed to capture and store runoff, three water treatment plants, District in-stream and off-stream groundwater recharge facilities, and the groundwater subbasins. In 2001, groundwater accounted for approximately 169,300 acre-feet of the total 382,500 acre-feet used in Santa Clara County.

2.1 Santa Clara County Groundwater Subbasins

Santa Clara County contains three interconnected groundwater subbasins that transmit, filter, and store vast quantities of water. These subbasins are shown in Figure 2-1.

The Santa Clara Valley Subbasin in the northern part of the county extends from Coyote Narrows at Metcalf Road to the county's northern boundary. The subbasin is bound on the east by the Diablo Range and on the west by the Santa Cruz Mountains; these two ranges nearly converge at the Coyote Narrows. The Santa Clara Valley Subbasin is approximately 22 miles long and 15 miles wide, with a surface area of 225 square miles. An extensive regional aquitard occurs within the northern areas of the subbasin at depths ranging from about 100 feet near the forebay to about 150 to 250 feet in the northern, interior portion of the basin and beneath San Francisco Bay. The thickness of this regional aquitard varies from about 20 feet to over 100 feet. The southern area and the margins of the subbasin are unconfined areas, or forebay areas, where clay-rich zones do not restrict recharge. The general groundwater gradient is from the edges of the basin toward San Francisco Bay, or generally in the direction of ground slope (SCVWD, 1989).

The Coyote Subbasin extends from Metcalf Road south to Cochrane Road, where it joins the Llagas Subbasin at a prescribed boundary that generally coincides with a groundwater divide. The Coyote Subbasin is approximately 7 miles long and 2 miles wide and has a surface area of approximately 15 square miles. The Coyote Subbasin is generally unconfined and has no significant, laterally extensive clay layers. The Coyote Subbasin generally drains north into the Santa Clara Valley Subbasin.

The Llagas Subbasin extends from Cochrane Road, in Morgan Hill, to the county's southern boundary. It is hydraulically connected to the Bolsa Subbasin of the Hollister Basin and bounded on the south by a prescribed boundary at the Pajaro River (the Santa Clara - San Benito County line). The Llagas Subbasin is approximately 15 miles long, 3 miles wide along its northern boundary, and 6 miles wide along the Pajaro River. A series of interbedded clay layers form an aquitard, which extends north from the Pajaro River. Areas outside the aquitard are forebay areas.

The three subbasins serve multiple functions. They transmit water through the gravelly alluvial fans of streams in the forebay area into the deeper confined aquifer zones of the central part of the valley. They filter water, making it suitable for drinking and for municipal, industrial, and agricultural uses. The subbasins also have vast storage capacity, together supplying as much as half of the annual water needs of the county.

2.2 Groundwater Production

Excessive reliance on the groundwater basin in the past resulted in severely lowered groundwater elevations and groundwater overdraft, which decreased fluid pressures in the aquifer systems and resulted in significant land subsidence. To protect groundwater resources and maximize water supply reliability, the District now conjunctively manages groundwater and surface water to provide a healthy, clean, reliable, and affordable water supply for Santa Clara County. Groundwater production is offset by the District's artificial recharge program and through natural recharge.

The District's Wells and Water Production Unit records groundwater production and administers well construction and destruction programs to protect the County's groundwater resources by ensuring that wells and other deep excavations are constructed, maintained, and destroyed such that they will not cause groundwater contamination. In 2001, the Wells and Water Production Unit issued 2,464 well permits, completed 1,851 well inspections, and destroyed 23 abandoned water wells.

The amount of groundwater extracted from Santa Clara County is recorded through the District's Water Revenue Program, which also tracks surface water, treated water, and recycled water production. District staff maintain accounts and records for more than 6,000 water production wells and approximately 27,000 monitoring wells. Although approximately half of the production wells within the county are not metered, metered wells produce the vast majority of groundwater used within the county. Where meters are not installed, groundwater production is estimated using efficiency or flow testing, power usage, or crop factors.

In 2001, approximately 115,400 acre-feet of groundwater was extracted from the Santa Clara Valley Subbasin. Almost all of this water was for municipal and industrial (M&I) uses (114,600 acre-feet), with approximately 800 acre-feet used for agriculture. It is estimated that 53,900 acre-feet of groundwater was extracted from the Coyote and Llagas Subbasins, which includes approximately 25,400 acre-feet for M&I uses and 28,500 acre-feet for agriculture. The total amount of groundwater extracted in 2001 (169,300 acre-feet) is an increase of about 5,000 acre-feet from the 164,000 acre-feet pumped in 2000; see Table 2-1 for a summary of groundwater production since 1981.

2.3 Groundwater Recharge

To balance groundwater production and to ensure the long-term sustainability of groundwater resources, the District has implemented an active conjunctive use program, whereby local and imported surface waters are used to replenish the groundwater subbasins through District facilities. The subbasins are also replenished by natural recharge.

2.3.1 Natural Recharge

Sources of natural recharge include rainfall, leakage from pipelines, seepage from surrounding hills, seepage into and out of the groundwater basin, and net irrigation return flows to the basin. The main source of natural recharge to the groundwater basin is the deep percolation of precipitation. Santa Clara County may be categorized as having a semi-arid climate. The average rainfall in San Jose is 14.50 inches, based on 127 years of record (Figure 2-2). Typically, 90 percent of the rainfall that occurs in a rainfall year (July 1 through June 30) occurs between November and April. The months between May and October are consistently dry and make up the remaining 10 percent of the rainfall year total. For San

Jose, January is the wettest month with an average of 2.93 inches rainfall and July is the driest with an average of 0.02 inches. The 2001 rainfall year total (from July 1, 2000 through June 30, 2001) recorded at the San Jose station was 14.08 inches, which is 97 percent of normal.

As can be seen from Figure 2-2, since the period of record began in 1874, Santa Clara County has experienced several relatively wet periods, in addition to extended periods of below average rainfall. Severe, short-term droughts, such as those that occurred in 1877 and from 1976-77 are also evident from the rainfall record. Since the early 1990s seasonal rainfall has generally been above normal with 2000 and 2001 seasons at 94 percent and 97 percent of the long-term average, respectively.

One method for depicting long-term trends in rainfall is to calculate the accumulated departure (percent) from the mean rainfall over the period of record (Figure 2-3). This figure graphically represents wet and dry periods; an upward trend (a positively sloping line) represents indicates a period of years which have received above normal rainfall whereas a downward trend (negatively sloping line) is indicative of a below normal rainfall period.

In addition to rainfall, there are other factors such as leakage from pipelines and irrigation return flows that serve to recharge the basin; however, these cannot be directly measured. Therefore, the natural recharge must be estimated.

Estimates of Natural Recharge

In the Santa Clara Valley Subbasin, the natural recharge to the primary water supply aquifer is estimated through the use of the groundwater flow model, which produced an estimate of approximately 26,000 acre-feet for 2001. As there is currently no flow model for the Coyote and Llagas Subbasins, the natural recharge has historically been estimated according to the following change in storage equation:

$$[\text{In}] - [\text{Out}] = \text{Change in Storage}$$

$$[\text{Natural Recharge} + \text{Artificial Recharge}] - [\text{Groundwater Pumping}] = \text{Change in Storage}$$

Artificial recharge and groundwater pumping are measured by the District and the change in storage for South County is estimated using groundwater elevation contour maps. Natural recharge is then back-calculated according to the equation above. There are several limitations to this analysis. First, the accuracy of the estimate is limited by the lack of a dynamic groundwater flow model capable of simulating changes in groundwater elevation with varying pumping and recharge conditions. There is also uncertainty in several of the terms in the equation above. For instance, groundwater pumping is not metered in the majority of wells in South County, but is often estimated as described in Section 2.2. The change in storage term is also estimated, based on groundwater contours interpolated from relatively sparse monitoring wells. Given these limitations, it was determined that there is insufficient data to estimate the 2001 South County natural recharge at this time. Development of a South County groundwater flow model is scheduled to begin in 2003 and it is expected that this will improve the District's ability to estimate natural recharge.

2.3.2 Artificial Recharge

To balance groundwater extraction, the District conducts artificial recharge operations along streams and in off-stream ponds. In-stream recharge occurs along about 70 miles of stream channels in the alluvial plain, upstream of the confined zone (Figure 2-4). Off-stream facilities include 71 ponds ranging in size from less than 1 acre to more than 20 acres. By releasing local and imported waters from local reservoirs or the distribution system, the District significantly enhances the recharge that would occur within these

facilities. Figure 2-4 shows the location of the District's percolation ponds; each symbol represents a group of ponds at each location. The Operations Planning and Analysis Unit produces an annual Operations Report to plan for distribution of water supplies to treatment plants and recharge operations. Through artificial recharge operations, approximately 129,100 acre-feet of water recharged the groundwater subbasins through in-stream and off-stream recharge facilities in 2001.

Almost 90,700 acre-feet of water recharged the Santa Clara Valley Subbasin through artificial recharge operations in 2001; this includes 50,000 acre-feet through the in-stream recharge program and 40,700 acre-feet recharged through off-stream ponds. Approximately 38,400 acre-feet of water recharged the Coyote and Llagas Subbasins through artificial recharge operations in 2001, including 29,900 acre-feet through in-stream recharge and 8,500 acre-feet through off-stream ponds.

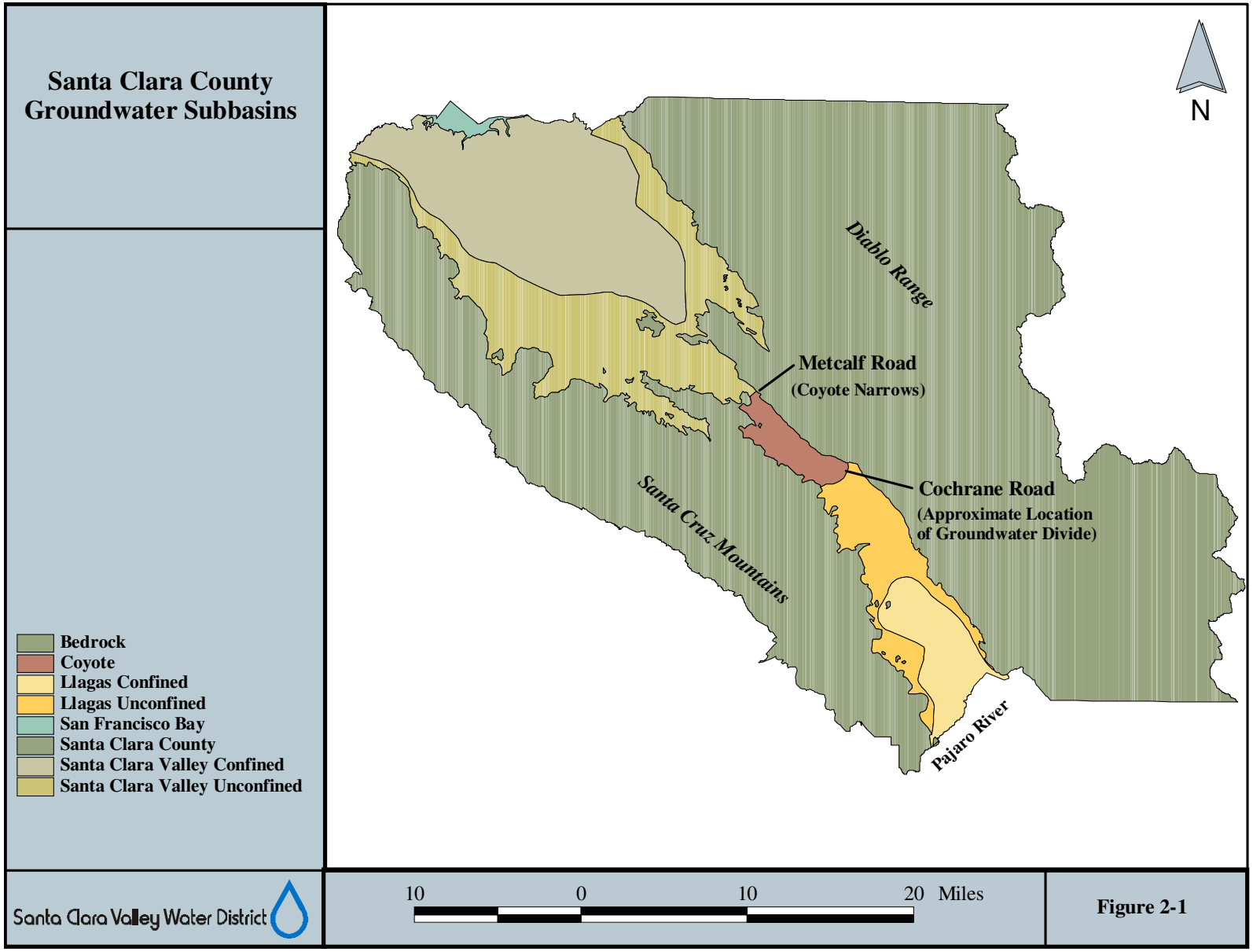
The District is currently evaluating the manner in which in-stream recharge facilities will be operated in the future. Temporary gravel dam operations have generally been discontinued throughout the county. As a result of environmental concerns regarding endangered fisheries, the District is a partner in the Fisheries and Aquatic Habitat Collaborative Effort (FAHCE). As a result of the FAHCE process, recharge operations along Stevens Creek, Guadalupe Creek, and Coyote Creek may be modified to improve fisheries habitat. The District will mitigate any impacts to water supply resulting from operational changes.

To ensure that District groundwater management programs designed to replenish the basin and to protect groundwater resources are effective, the District has implemented rigorous monitoring networks to track groundwater elevations, groundwater quality, and land subsidence. These programs and 2001 monitoring results are summarized in the following sections.

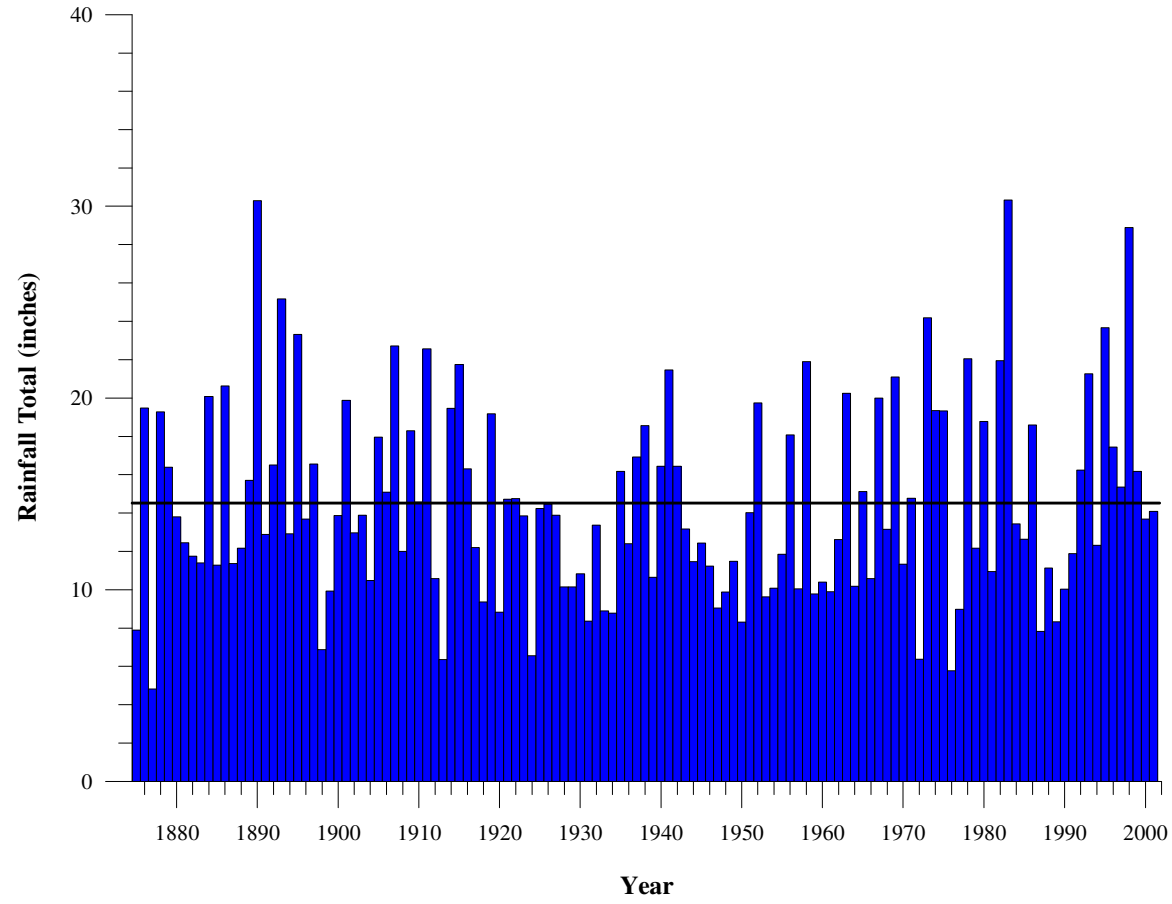
Table 2-1
Groundwater Production Summary

	Santa Clara Valley Subbasin			Coyote and Llagas Subbasins[1]			
Calendar Year	**Ag (ac-ft)**	**M&I (ac-ft)**	**Total (ac-ft)**	**Ag (ac-ft)**	**M&I (ac-ft)**	**Total (ac-ft)**	**Total District Production (ac-ft)**
1981	8,625	151,338	159,964	-	-	-	-
1982	6,334	135,039	141,373	-	-	-	-
1983	5,612	147,121	152,733	-	-	-	-
1984	6,307	172,301	178,608	-	-	-	-
1985	6,214	174,851	181,065	-	-	-	-
1986	5,505	168,703	174,208	-	-	-	-
1987	5,922	165,558	171,479	-	-	-	-
1988	5,523	150,262	155,785	24,955	20,875	45,830	201,615
1989	4,805	84,005	88,810	24,389	17,148	41,538	130,348
1990	4,797	101,923	106,719	24,884	17,652	42,537	149,256
1991	3,791	88,422	92,212	28,313	16,884	45,198	137,410
1992	3,476	103,728	107,204	30,144	17,484	47,628	154,832
1993	3,086	101,851	104,937	27,761	18,233	45,994	150,931
1994	2,989	119,966	122,956	30,351	18,866	49,217	172,172
1995	2,458	110,134	112,592	29,080	19,187	48,267	160,859
1996	2,580	109,849	112,429	29,873	19,730	49,602	162,031
1997	1,910	118,515	120,425	32,757	21,707	54,464	174,889
1998	1,101	99,157	100,257	25,810	20,008	45,818	146,075
1999	1,087	106,355	107,442	29,142	23,764	52,906	160,347
2000	972	111,550	112,522	26,883	24,533	51,416	163,938
2001	753	114,605	115,358	28,510	25,437	53,947	169,305

[1] District assumed management of South County subbasins in 1987. No earlier groundwater production data is available.


Santa Clara County
Groundwater Subbasins
N
Diablo Range
Metcalf Road
(Coyote Narrows)
Cochrane Road
(Approximate Location
of Groundwater Divide)
Santa Cruz Mountains
Pajaro River
Bedrock
Coyote
Llagas Confined
Llagas Unconfined
San Francisco Bay
Santa Clara County
Santa Clara Valley Confined
Santa Clara Valley Unconfined
Santa Clara Valley Water District
10 0 10 20 Miles
Figure 2-1

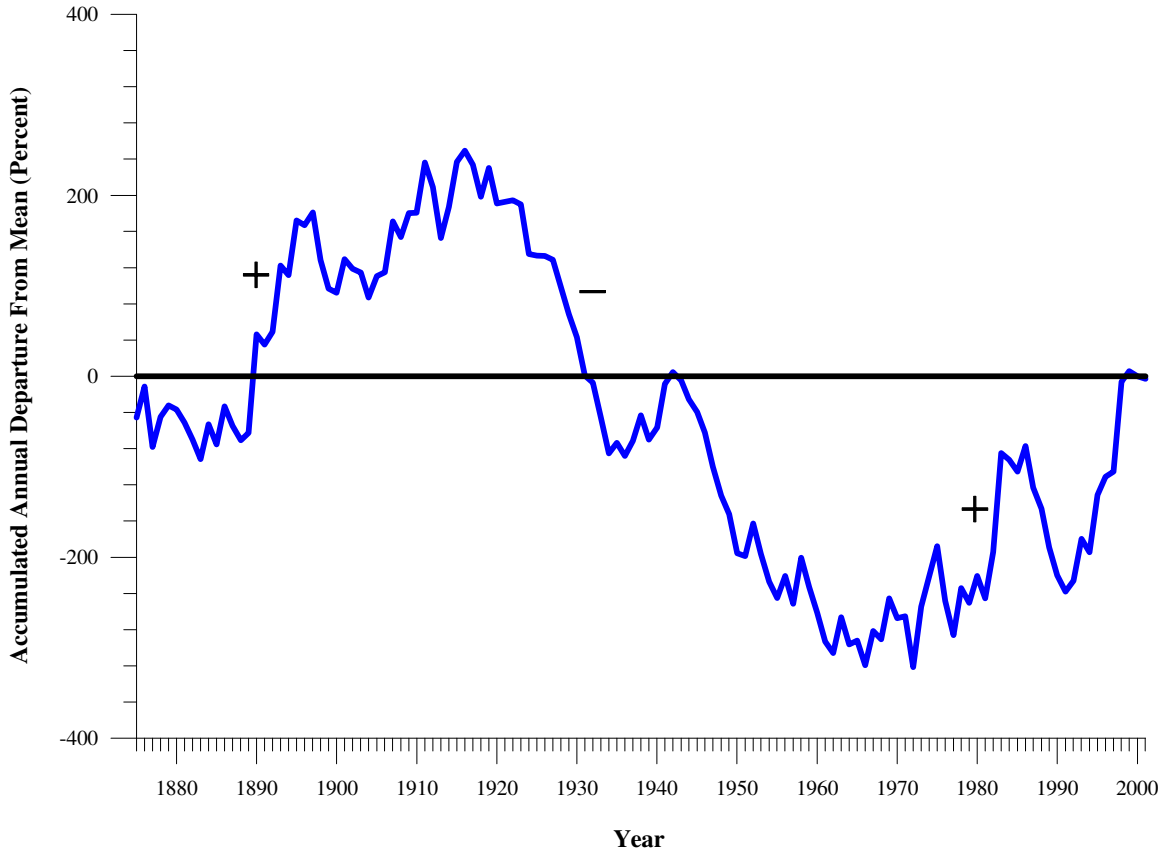
Total Annual Rainfall at San Jose Station (Rainfall Year)



Santa Clara Valley Water District

Figure 2-2

Acccumulated Annual Departure from 127-Year Average Rainfall at San Jose

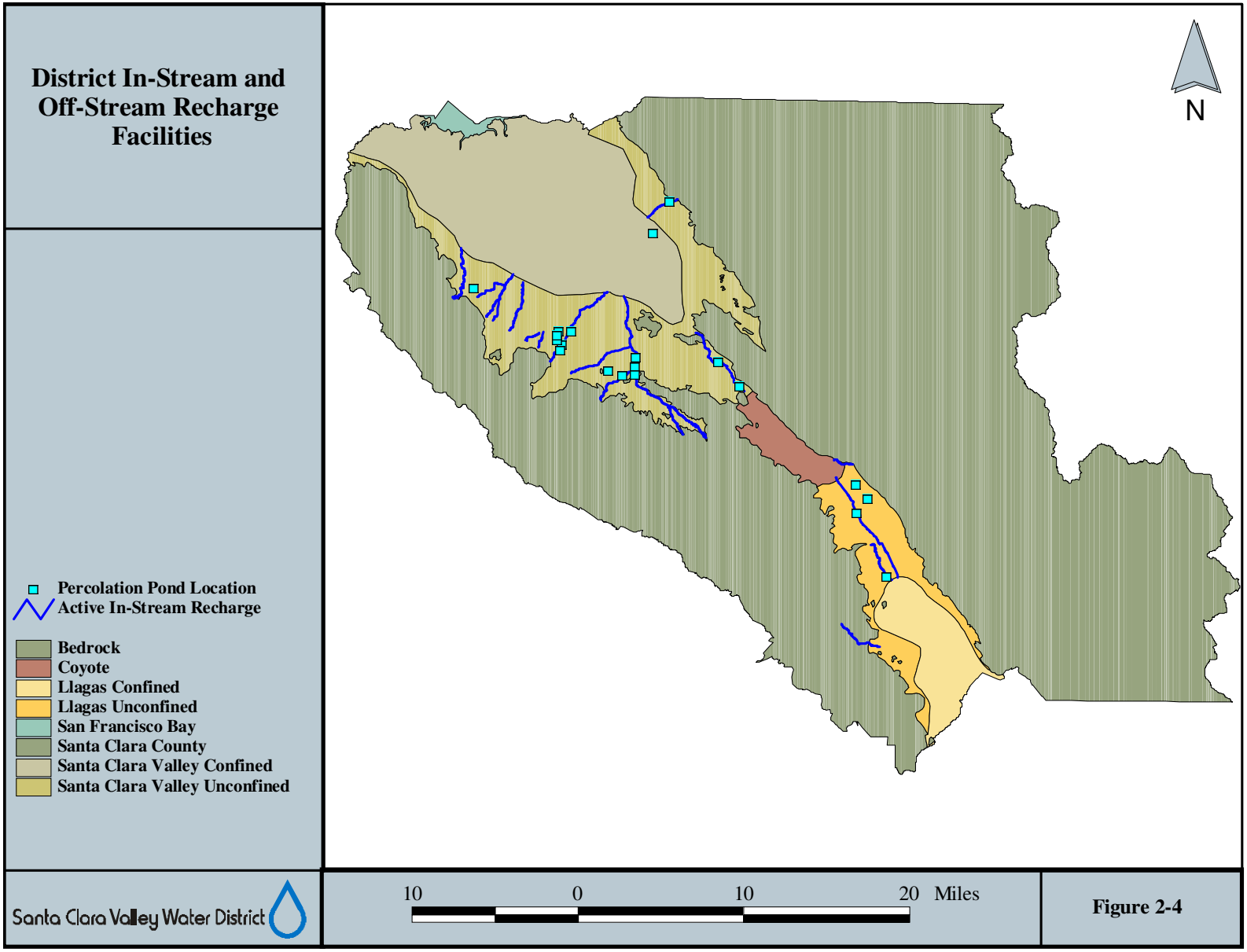


\+ **Positive slopes represent wet periods**

– **Negative slopes represent dry periods**

Santa Clara Valley Water District

Figure 2-3


District In-Stream and Off-Stream Recharge Facilities
Percolation Pond Location
Active In-Stream Recharge
Bedrock
Coyote
Llagas Confined
Llagas Unconfined
San Francisco Bay
Santa Clara County
Santa Clara Valley Confined
Santa Clara Valley Unconfined
N
Santa Clara Valley Water District
10 0 10 20 Miles
Figure 2-4

3.0 Groundwater Elevation Monitoring

Groundwater elevations are affected by natural and artificial recharge and groundwater extraction, and are an indicator of how much groundwater is in storage at a particular time. Both low and high elevations can cause adverse conditions. Low groundwater levels can lead to land subsidence and shallow groundwater can lead to nuisance conditions for below ground structures and necessitate dewatering.

The District has been collecting groundwater elevation data since it was first formed as a conservation district in 1929. Groundwater elevation data is used to evaluate current groundwater conditions and land subsidence, to optimize recharge efforts, to assess groundwater storage, and to support modeling efforts. Consultants, other agencies, and the public also request groundwater elevation data collected by the District. Through frequent monitoring of groundwater elevations, the District can evaluate groundwater supply conditions and can formulate strategies to ensure adequate groundwater supplies, prioritize recharge activities, and minimize any adverse impacts.

The District collects groundwater elevation field measurements and obtains groundwater elevation measurements from other agencies for a total of approximately 215 wells. Most wells in the program are privately owned and their locations are fairly evenly distributed among the three groundwater subbasins (Figure 3-1). Although the District collects groundwater elevation data from many wells throughout the county, most wells were designed as production wells with perforations across multiple water bearing zones to increase groundwater production. There are relatively few wells that measure groundwater elevations in a single aquifer.

In 2001, the District collected groundwater elevation data for approximately 215 wells. 110 of these were measured monthly, while the remaining 105 were measured on a quarterly basis (Figure 3-1). As many of the monitoring wells are production wells, the District makes every effort to measure only static groundwater elevations. Among the data collected was monthly elevation data for "index wells" for each of the valley's three groundwater subbasins. These index wells have been chosen because they are considered to be representative of general groundwater elevation trends within each subbasin. Figure 3-1 shows the location of the index wells in each subbasin.

All groundwater elevation data is maintained in the District's Groundwater Monitoring (GM) database. The District will evaluate the possibility of making this data accessible through the Internet, as this data is frequently used both within and outside the District. Summaries of groundwater elevation monitoring results for each subbasin are presented below.

3.1 Santa Clara Valley Subbasin

Groundwater elevations for the Santa Clara Valley Subbasin index well through 2001 are shown in Figure 3-2. The period of record begins in 1915, which marks the beginning of a steady 20 year decline in groundwater levels and coincides with a period when rainfall was generally below average (see Figure 2-2). In 1935 and 1936 the District completed six water conservation reservoirs. This additional local storage, coupled with an above-average period of rainfall, resulted in an increase in groundwater levels which continued until the early 1940s. Following this abbreviated period of groundwater rise, a long period of decline commenced until the lowest groundwater level of record was reached in October of 1964. This period of groundwater level decline was due largely to a period of below-average rainfall and an increasing water supply demand as a result of post-WWII development and population growth. In 1965 the District began receiving the first deliveries of imported water through the State's South Bay Aqueduct (SBA), part of the State Water Project. Since the introduction of SBA, groundwater levels have

generally increased annually, with the exception of two significant drought periods beginning in 1977 and 1987 (Figure 3-2).

2001 groundwater elevations in the Santa Clara Valley Subbasin index well are approximately 20 feet below the historic maximum levels and are over 200 feet above the minimum groundwater levels for the period of record. Additionally, the minimum 2001 groundwater elevation recorded in the fall is approximately 70 feet above the subsidence threshold for this area. Subsidence thresholds, or groundwater elevations below which significant subsidence will occur, are discussed in detail in section 4.0. In general, groundwater elevations throughout the subbasin were quite high in 2001.

Groundwater elevations in the Santa Clara Valley Subbasin index well are used to measure District performance in meeting the Board Ends Policy which directs staff to ensure "Groundwater supplies are sustained." As groundwater levels and storage in the Santa Clara Valley Subbasin in 2001 were near historical high levels and were well above the subsidence threshold for that region, it was determined that District performance in meeting this target exceeded expectations.

To provide a regional and general view of 2001 groundwater elevations in the Santa Clara Valley Subbasin, contour maps were produced. It should be noted that contour maps for the Santa Clara Valley Subbasin are fairly difficult to interpret simply by contouring groundwater elevation data from wells. As the majority of wells are screened in multiple zones, data from the wells produces a contour map that represents composite groundwater elevations from different water bearing zones. Figures 3-3 and 3-4 are groundwater contour maps for spring and fall 2001 groundwater elevations computed by the North County groundwater model. These elevations are associated with a specific model layer that represents the primary water supply aquifer. In general, groundwater elevations in the Santa Clara Valley Subbasin did not change significantly between the spring and fall of 2001.

3.2 Coyote Subbasin

General groundwater elevations in the Coyote Subbasin are represented by three index wells (Figure 3-5). Minimum groundwater levels for the period of record for all three Coyote Subbasin index wells were recorded in the late 1940s. Since that time, groundwater elevations in index wells 09S02E02J002 and 09S02E12E001 exhibit a gradual increase in groundwater elevation with time. The hydrograph for index well 09S03E16C001, which is located near the border of the Coyote and Llagas Subbasins, does not show the same general increasing trend in groundwater elevations. This is likely the result of the fact that the well is within a cone of depression from nearby pumping. The maximum groundwater levels for the period of record occurred in 1983 at all three index wells. Current seasonal fluctuations in groundwater elevations are at least 25 feet above minimum levels recorded in the late 1940s and at least 10 feet below the maximum levels recorded in 1983. No subsidence threshold level has been established for the Coyote Subbasin due to the lack of significant confining clay layers.

General groundwater elevation conditions for the Coyote Subbasin can be seen on contour maps showing lines of equal groundwater elevation for spring and fall 2001 (Figures 3-6 and 3-7). Data from approximately 50 wells was used to construct these contour maps. These maps show a fairly significant decline in groundwater elevations between the spring and fall of 2001.

3.3 Llagas Subbasin

The hydrograph for the Llagas Subbasin index well is shown in Figure 3-8. The effects of the 1977 and 1987 droughts are clearly indicated by pronounced declines in groundwater elevations in the index well. In the 30-year period of record, the minimum groundwater elevation was recorded in the fall of 1977 and the maximum groundwater elevation was recorded in the spring of 1998. 2001 groundwater levels were

approximately 10 feet below the maximum and approximately 75 feet above the minimum groundwater elevations recorded for the period of record.

Groundwater elevations in the Llagas Subbasin index well are also used to measure District performance in meeting the Board Ends Policy which directs staff to ensure "Groundwater supplies are sustained." The target level for the Llagas Subbasin corresponds to the minimum groundwater elevation recorded in the index well in 1987, the year the District assumed management of South County from the Gavilan Water District. Although annual water levels and storage in the Llagas Subbasin have decreased in the late 1990s, groundwater elevations remain above the target level.

General groundwater elevation conditions for the Llagas Subbasin can be seen on contour maps showing lines of equal groundwater elevation for spring and fall 2001 (Figures 3-6 and 3-7). These maps show a fairly significant decline in groundwater elevations between the spring and fall of 2001, particularly in the Llagas Subbasin. It is important to note that the groundwater elevations represented are composite elevations from wells perforated across multiple water bearing zones, and therefore cannot be considered to be entirely representative of either the lower confined or upper aquifer zones.

3.4 Change in Storage

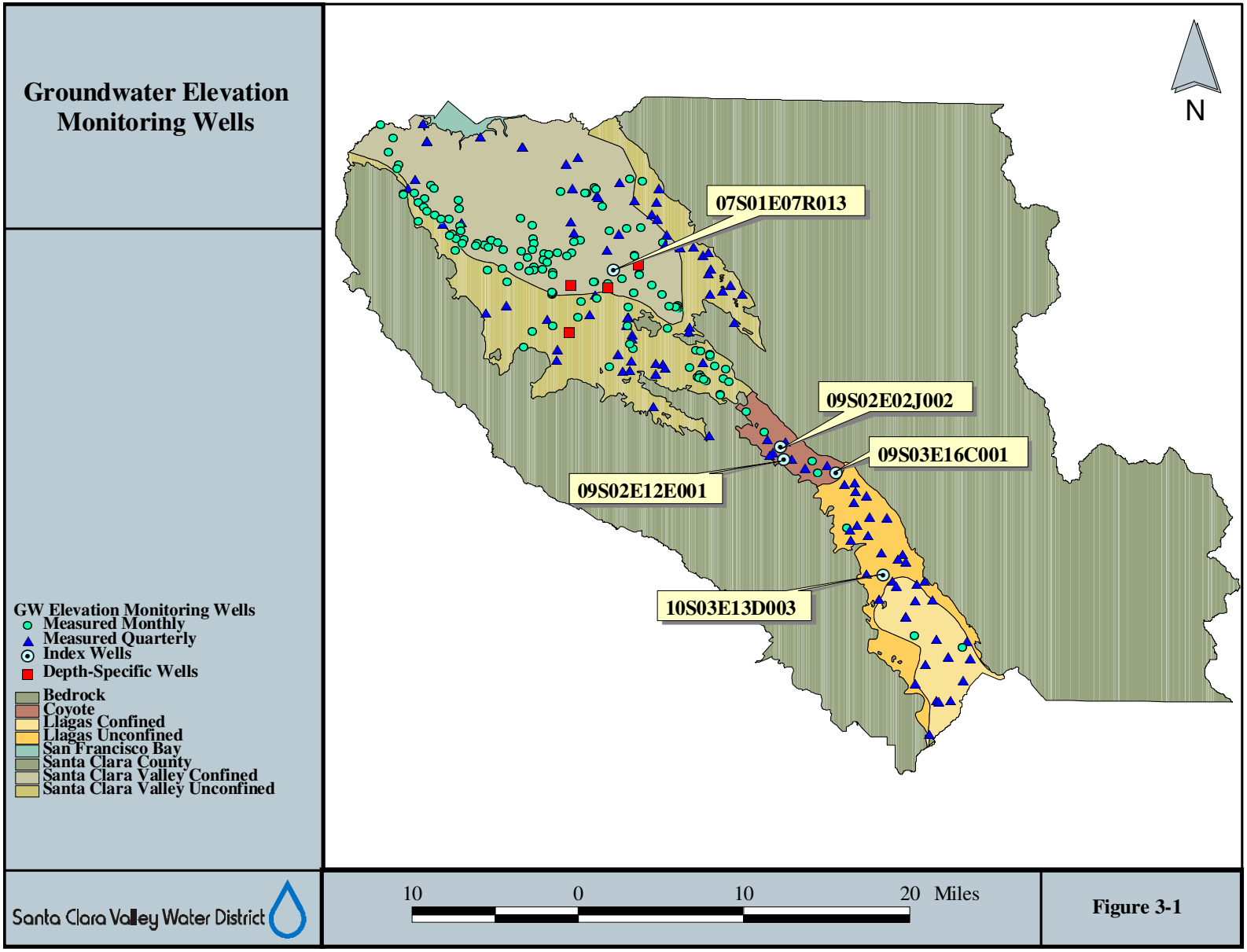
Groundwater is in a constant state of flux; it enters the Santa Clara Valley Subbasin through natural or artificial recharge and leaves the subbasin through production wells or subsurface flow. If the volume of groundwater leaving and entering the subbasin is balanced, the subbasin is in a steady state condition and there is no change in storage. If more groundwater is leaving the subbasin than is entering, the amount of groundwater in storage is decreased. The opposite is true for a net increase in storage; that is, more groundwater enters the subbasin than exits.

3.4.1 North County

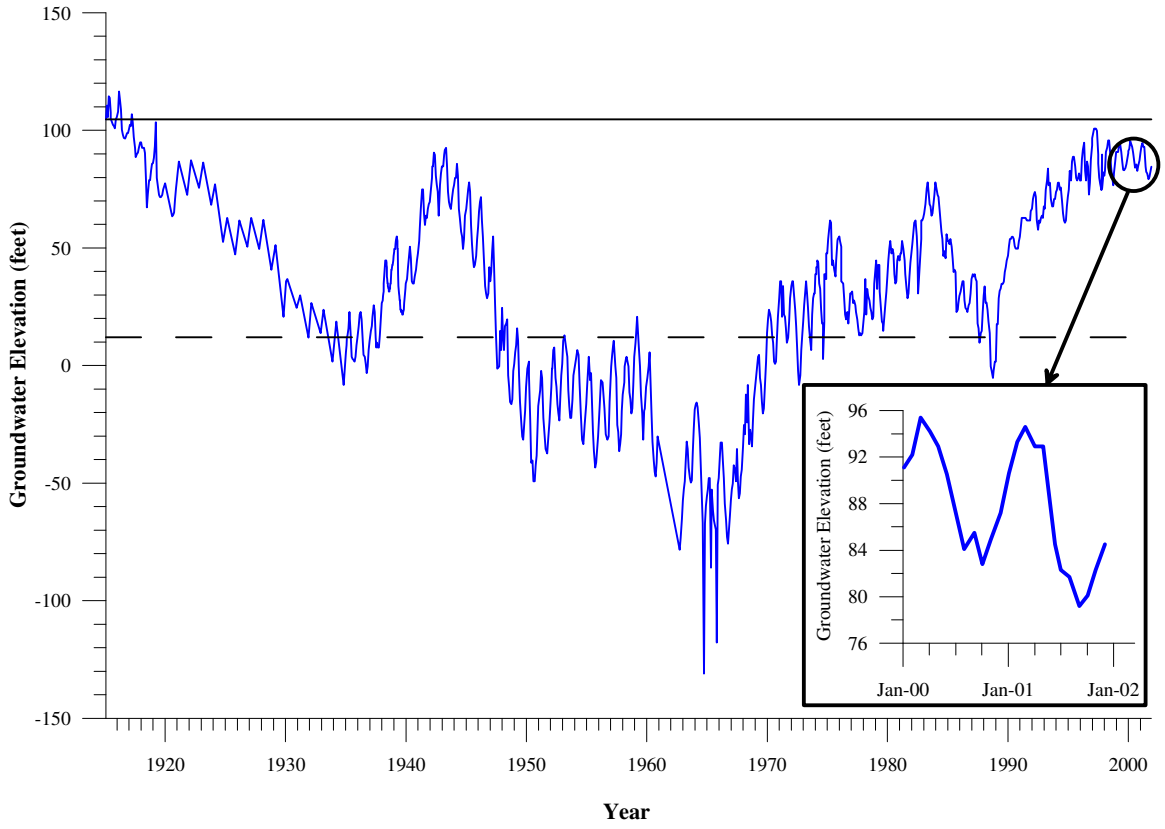
In the Santa Clara Valley Subbasin, the change in storage is estimated using the groundwater flow model. Using this method, it is estimated that groundwater storage increased in 2001 by approximately 12,500 acre-feet. Figure 3-9 shows the annual change in storage in the Santa Clara Valley Subbasin since 1993. The model results indicate that between 1993 and 2001, more groundwater has been put into storage than has been withdrawn from the subbasin.

3.4.2 South County

As there is currently no South County groundwater flow model, the change in storage is calculated using groundwater elevation contour maps. The subbasins are divided into "cells" and the difference in groundwater elevation from fall 2000 to fall 2001 is determined for each cell using the contour maps. This difference is then multiplied by the aquifer storage coefficient and area for each cell to determine the 2001 change in storage for the Coyote and Llagas Subbasins. Using this method, it is estimated that the volume in storage decreased in the Coyote and Llagas Subbasins, by approximately 300 acre-feet and 21,000 acre-feet, respectively. Figure 3-10 shows the annual change in storage for the Coyote and Llagas Subbasins since 1988.


Groundwater Elevation Monitoring Wells
N
07S01E07R013
09S02E02J002
09S03E16C001
09S02E12E001
10S03E13D003
GW Elevation Monitoring Wells
Measured Monthly
Measured Quarterly
Index Wells
Depth-Specific Wells
Bedrock
Coyote
Llagas Confined
Llagas Unconfined
San Francisco Bay
Santa Clara County
Santa Clara Valley Confined
Santa Clara Valley Unconfined
Santa Clara Valley Water District
10 0 10 20 Miles
Figure 3-1

Hydrograph for the Santa Clara Valley Subbasin Index Well



Groundwater Elevation Well 07S01E07R013

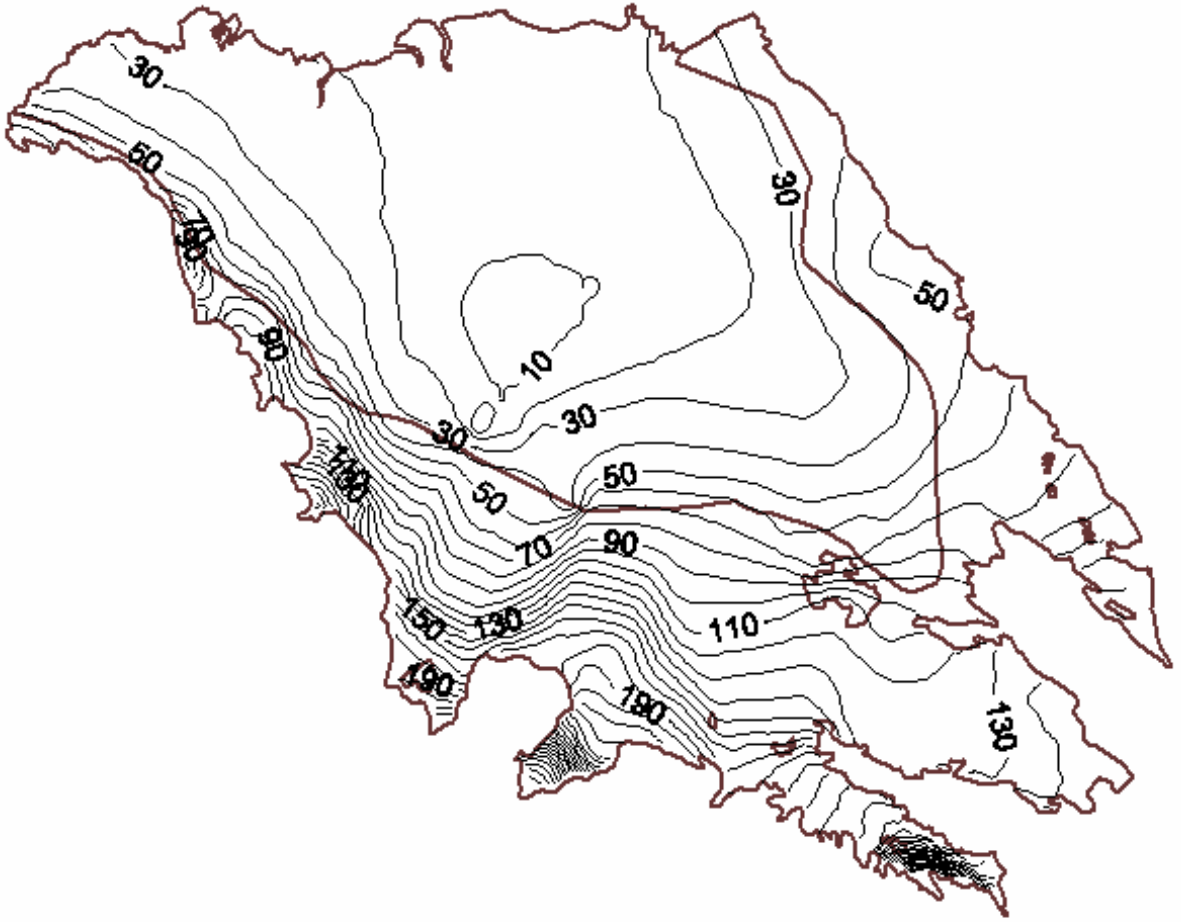
Surface Elevation (104.7 Feet)

Subsidence Threshold (12.0 Feet)

Santa Clara Valley Water District

Figure 3-2

North County
Groundwater Elevation
Contour Map
Spring 2001



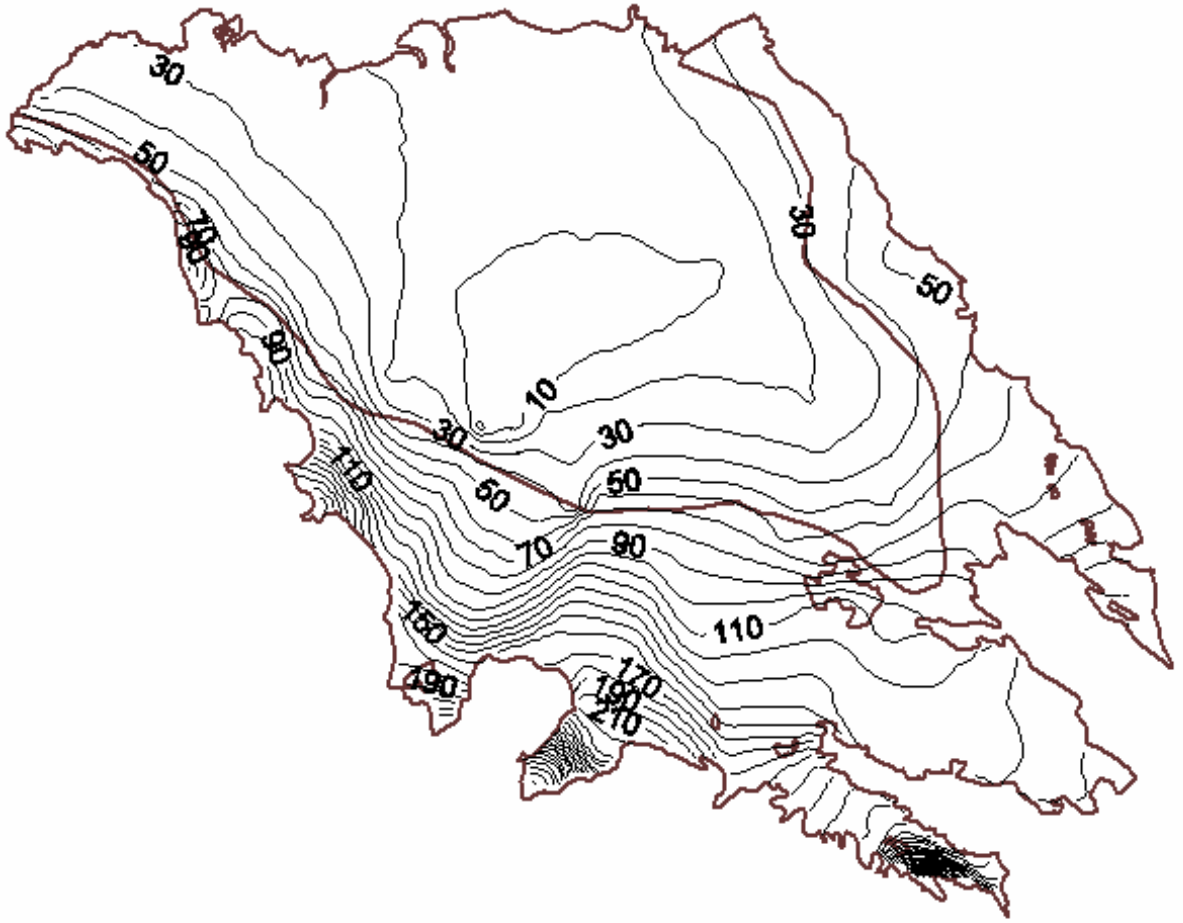
Principal Aquifer Zone
Groundwater Elevation Contours

Contour Line (Feet)
Contour Interval 10 Feet

Santa Clara Valley Water District

Figure 3-3

North County
Groundwater Elevation
Contour Map
Fall 2001



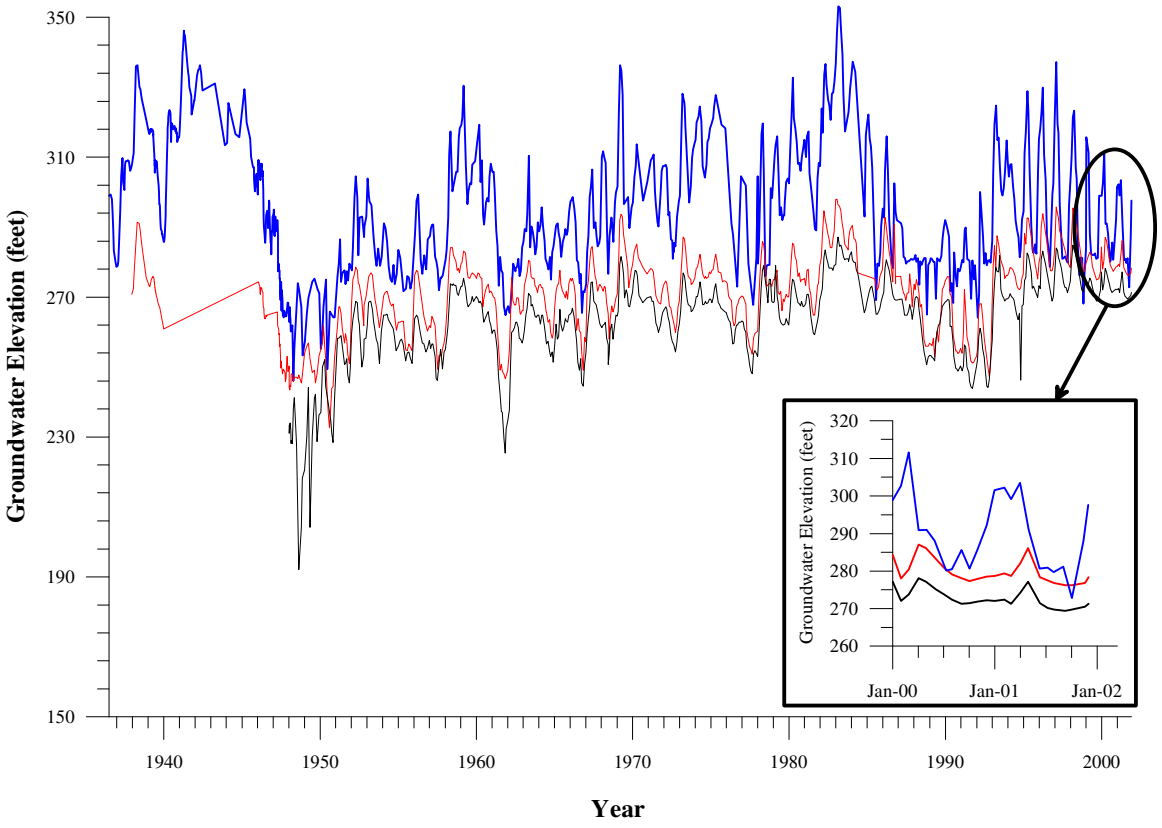
Principal Aquifer Zone
Groundwater Elevation Contours

Contour Line (Feet)
Contour Interval 10 Feet

Santa Clara Valley Water District

Figure 3-4

Hydrograph for Coyote Subbasin Index Wells

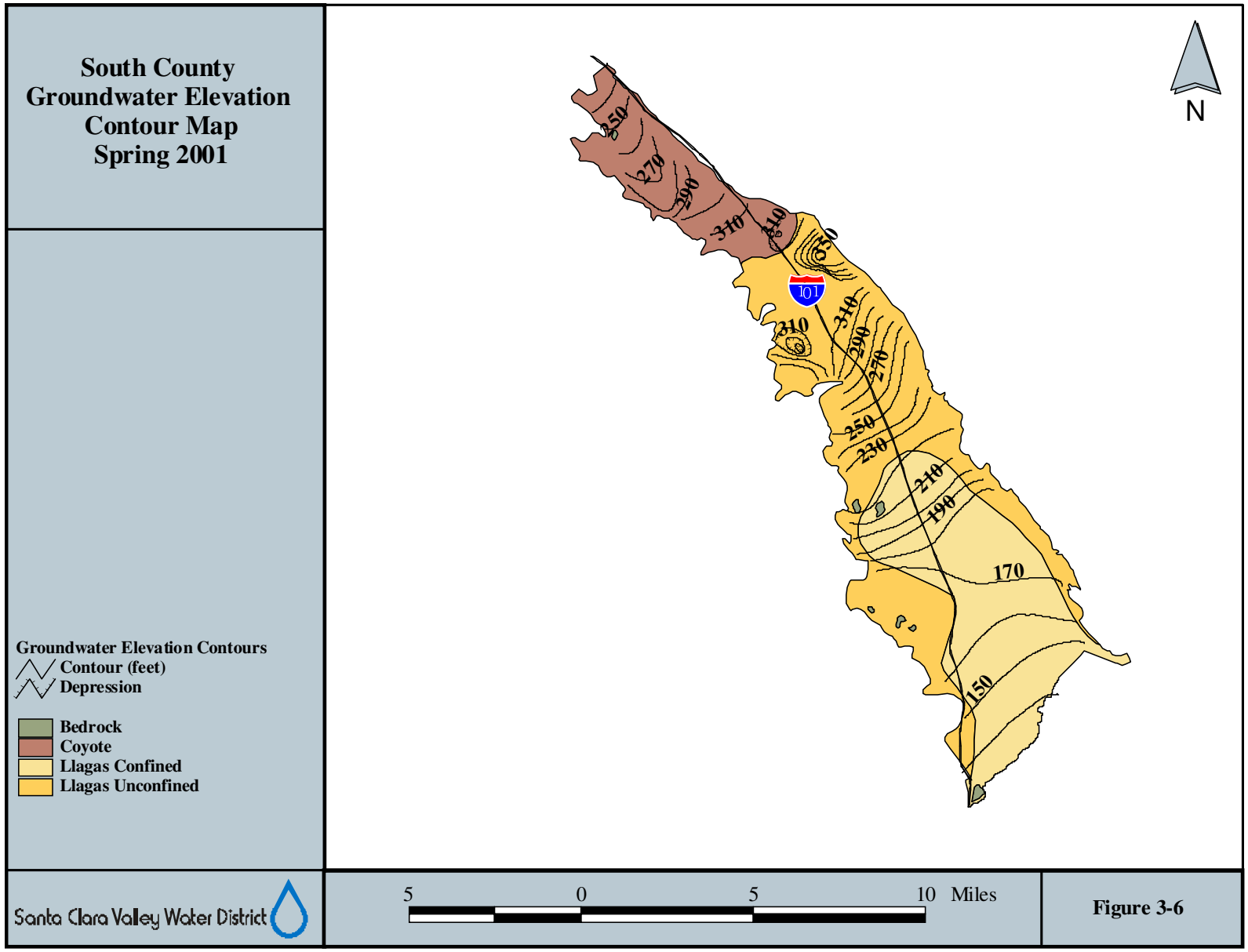


Well Number

- 09S03E16C001
- 09S02E12E001
- 09S02E02J002

Santa Clara Valley Water District

Figure 3-5


South County
Groundwater Elevation
Contour Map
Spring 2001
N
250
270
290
310
330
350
101
310
310
290
270
250
230
210
190
170
150
Groundwater Elevation Contours
Contour (feet)
Depression
Bedrock
Coyote
Llagas Confined
Llagas Unconfined
Santa Clara Valley Water District
5
0
5
10 Miles
Figure 3-6

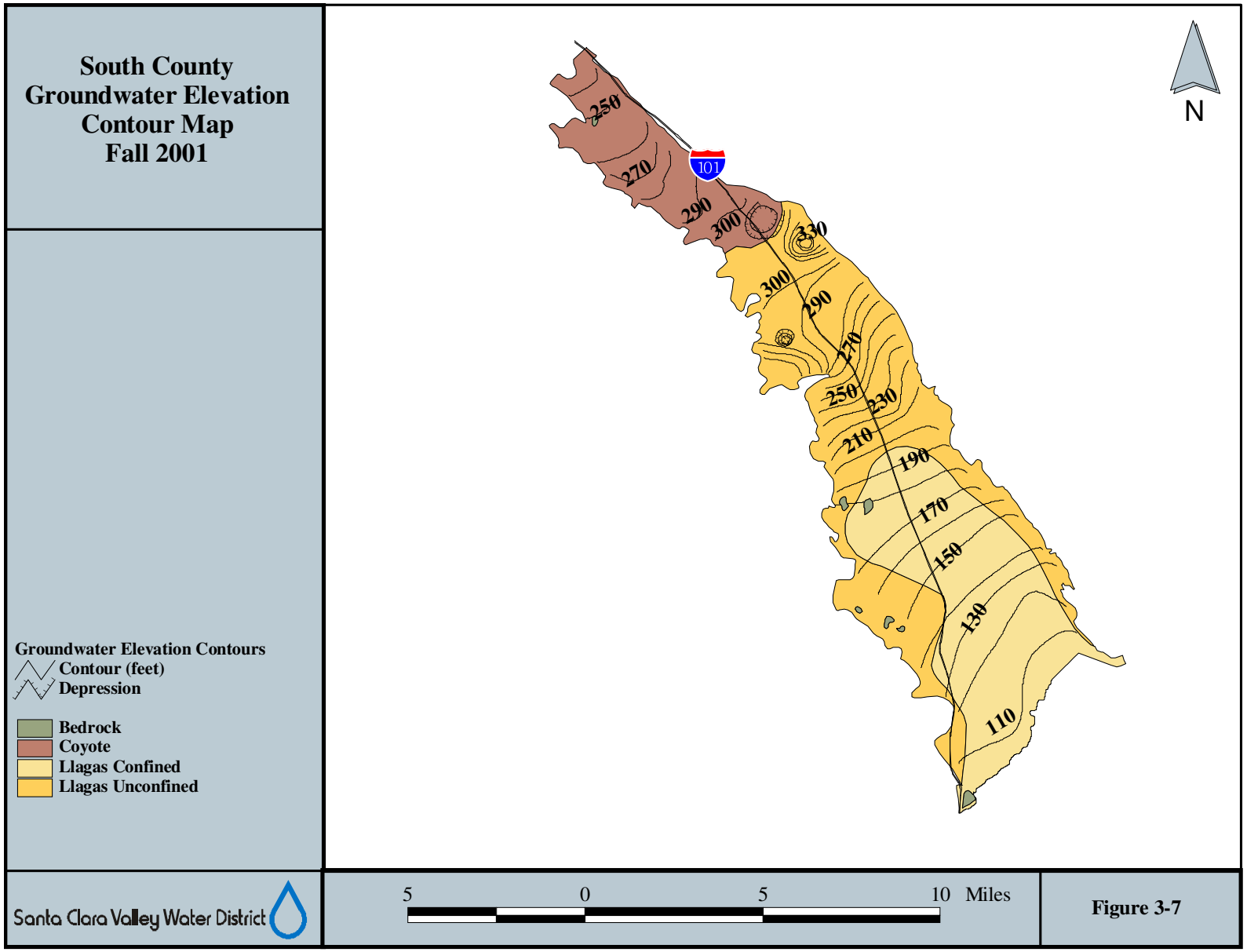
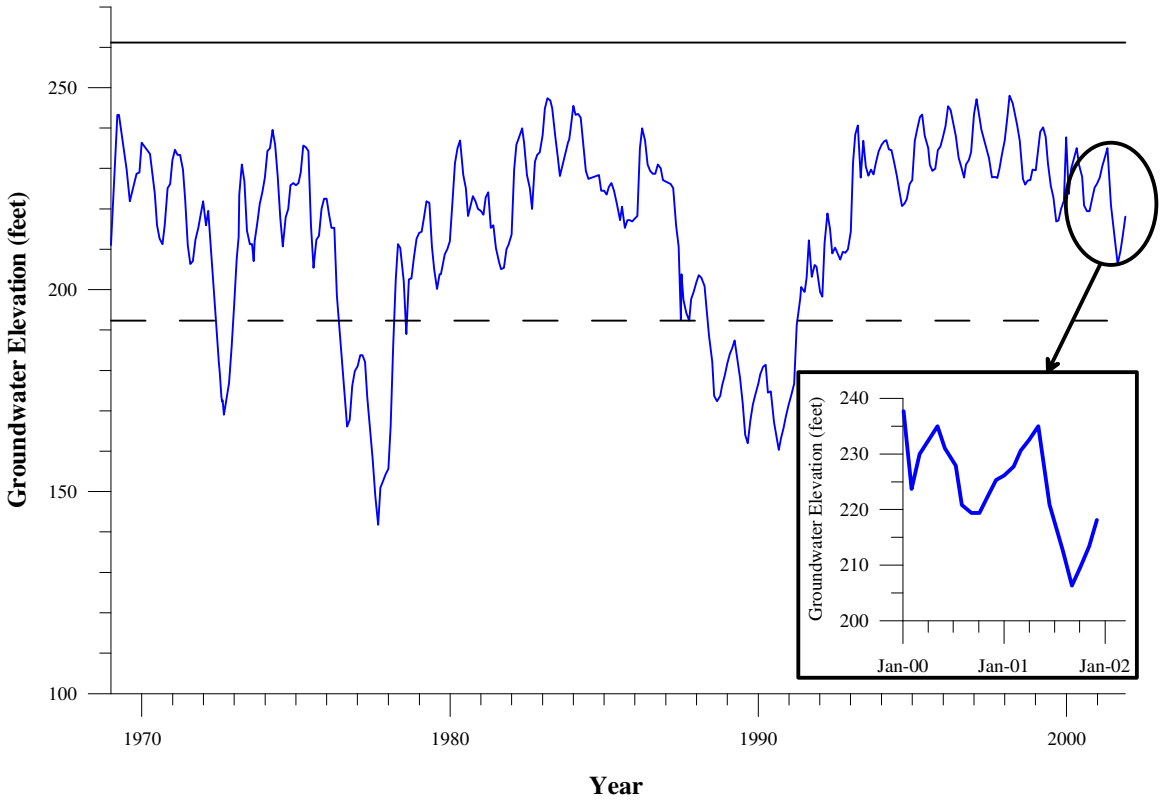

South County
Groundwater Elevation
Contour Map
Fall 2001
Groundwater Elevation Contours
Contour (feet)
Depression
Bedrock
Coyote
Llagas Confined
Llagas Unconfined
250
270
290
300
330
300
290
270
250
230
210
190
170
150
130
110
101
N
Santa Clara Valley Water District
5
0
5
10 Miles

Figure 3-7

Hydrograph for the Llagas Subbasin Index Well



Groundwater Elevation Well 10S03E13D003

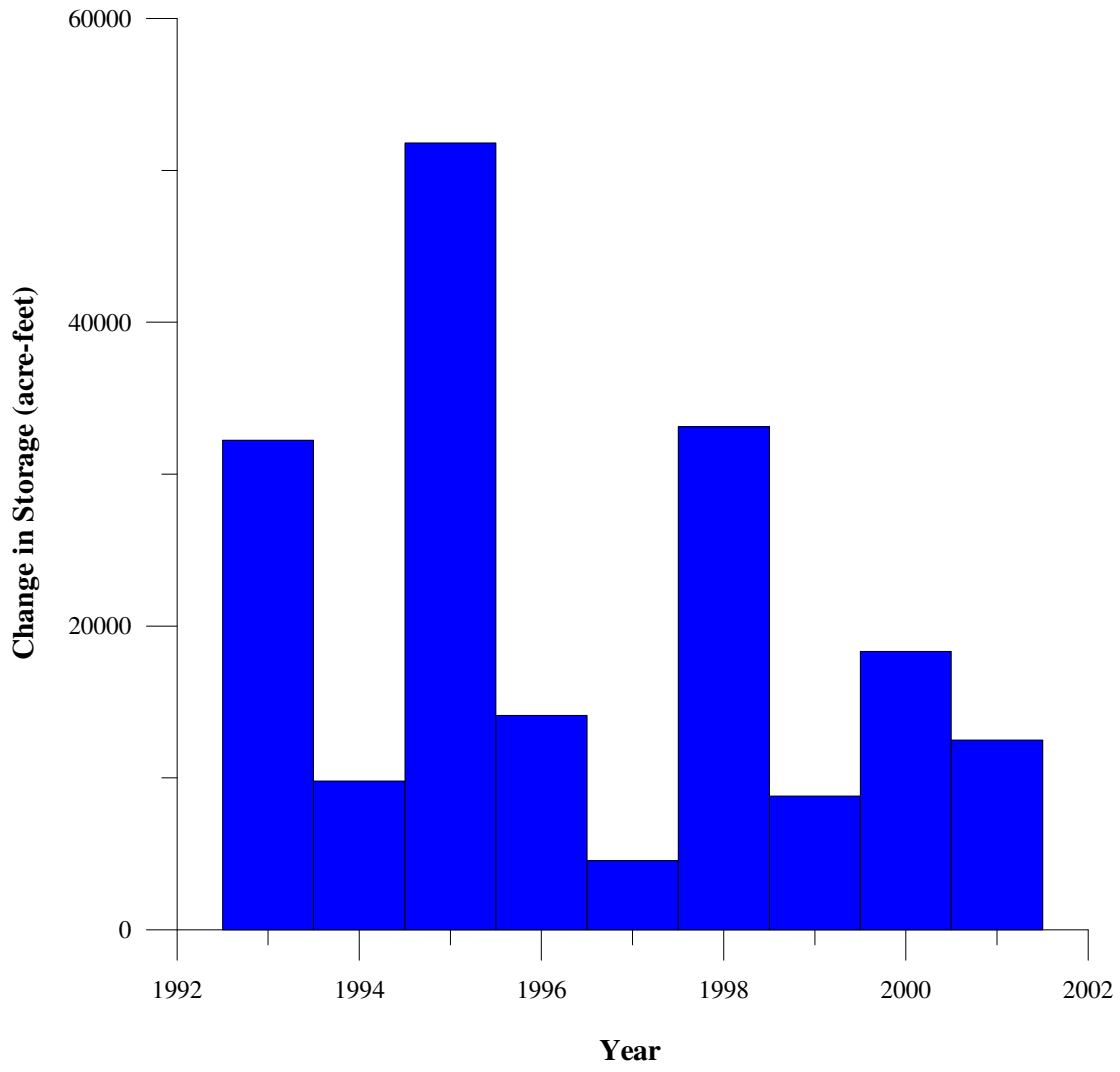
Surface Elevation (261.2 Feet)

Target Elevation (192.3 Feet)

Santa Clara Valley Water District

Figure 3-8

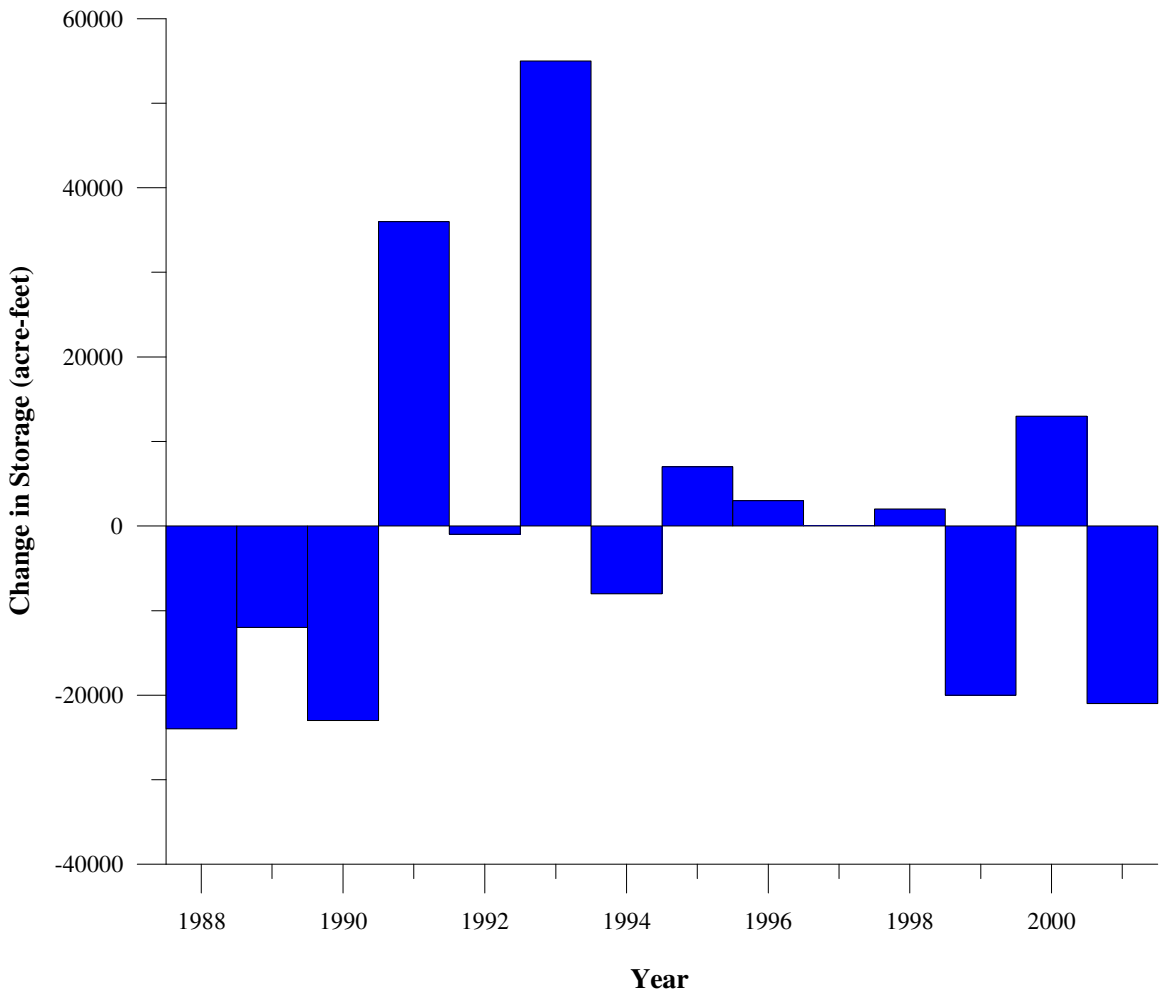
Annual Change in Storage for the Santa Clara Valley Subbasin since 1993



Santa Clara Valley Water District

Figure 3-9

Annual Change in Storage for the Coyote and Llagas Subbasins since 1988



Santa Clara Valley Water District

Figure 3-10

4.0 Land Subsidence Monitoring

Land subsidence occurs in the Santa Clara Valley when groundwater overdraft significantly reduces the fluid pressure in the pores of aquifer systems. This results in the compression of clay materials and the sinking of the land surface. Subsidence in northern Santa Clara County was first detected in 1919; by 1970, cumulative subsidence in San Jose was approximately 13 feet.

Costs associated with land subsidence are high, as it can lead to saltwater intrusion that degrades groundwater quality, and flooding that damages buildings and infrastructure. Historical land subsidence necessitated the construction of additional dikes, levees, and flood control facilities to protect properties from flooding. Excessive historical groundwater production resulted in significant dewatering of clay materials, and a small component of residual subsidence can still be measured today. However, through the introduction of imported water and the District's active recharge program, the rate of inelastic land subsidence in the Santa Clara Valley Subbasin has been reduced to less than 0.01 feet per year in the years since the early 1970s.

No subsidence thresholds have been established for the Coyote or Llagas Subbasins, as there has been no analysis of the occurrence of subsidence in South County. In the spring of 2002, the Groundwater Management Unit and researchers from U.C. Berkeley began a cooperative study to determine if permanent land subsidence due to groundwater production has occurred in South County. Researchers are analyzing high-resolution satellite images and groundwater production data to determine if there are significant changes in land surface elevation that can be attributed to groundwater pumping.

The District actively monitors land subsidence in the Santa Clara Valley Subbasin at ten subsidence index wells, including two extensometer locations, and along two level circuits (Figure 4-1).

4.1 Extensometers

In 1960, the U.S. Geological Survey (USGS) installed extensometers, or compaction recorders, in two 1,000-foot boreholes drilled in the centers of historical subsidence sites in Sunnyvale and San Jose (Figure 4-1). Since the early 1980s, the District has monitored these extensometers to measure the rate and magnitude of expansion and compression that occurs between the land surface and the bottom of the well.

In the fall of 1998, the District installed electronic instrumentation at the San Jose extensometer site; depth-to-water and deformation readings are measured every 10 minutes, and are then averaged hourly and recorded on a data storage module. In the summer of 2001, electronic instrumentation for measuring deformation was installed at the Sunnyvale extensometer. Both the San Jose and Sunnyvale extensometer sites are visited quarterly to collect the hourly readings and analog charts, and to check instrument calibration.

Hourly depth-to-water and deformation readings from the San Jose extensometer are shown in Figure 4-2. The period plotted represents almost two years of data beginning on January 1, 2000 and ending on December 11, 2001. The two-year period of data reflects the larger scale seasonal fluctuations in water levels and associated compaction and expansion of the aquifer system in San Jose. The hourly data also illustrate the rapid fluctuations in depth-to-water (shown in blue) resulting from pumping within the high production well field in which the extensometer is located. It should be noted that "deformation" (as shown in black on the graph) does not necessarily correspond to an equivalent amount of permanent land subsidence. Stress-strain curves for the San Jose extensometer indicate that nearly all the deformation that occurred in 2001 was in the elastic, or recoverable, range.

4.2 Subsidence Index Wells

The District has established subsidence thresholds, or groundwater elevations below which significant subsidence will occur, as the lower threshold for acceptable groundwater elevations in the Santa Clara Valley Subbasin. These thresholds were determined using a subsidence model called PRESS (Predictions Relating Effective Stress and Subsidence). PRESS is a one-dimensional numerical model used to calculate subsidence as a result of changes in water levels. The District established a tolerable rate of subsidence of 0.01 feet per year, which is based on the arithmetic average of historical subsidence and rebound as measured in the Sunnyvale and San Jose extensometers for the eleven-year period 1980-1990 (Geoscience, 1991). The PRESS model was used to determine water levels corresponding to this subsidence rate in the vicinity of ten subsidence index wells throughout the Santa Clara Valley Subbasin (Figure 4-1 and Table 4-1). Groundwater management and water supply planning activities are designed to minimize the risk of subsidence by maintaining groundwater elevations above these thresholds in the Santa Clara Valley Subbasin.

In 2001, water level data were collected monthly or quarterly from eight of the ten original subsidence index wells. Two of the subsidence index wells have been recently destroyed by the well owners; the District is currently investigating suitable replacements in the vicinity of these destroyed wells. Minimum groundwater levels for eight of the subsidence index wells in the Santa Clara Valley Subbasin are summarized in Table 4-1. The minimum groundwater levels (corresponding to the maximum aquifer stress) generally occur in the fall. As shown in Table 4-1, all minimum groundwater elevations at the PRESS index wells for 2001 were well above the established subsidence thresholds.

4.3 Level Circuit

Subsidence in northern Santa Clara County was first detected in 1919 after an initial level survey conducted in 1912 by the National Geodetic Survey. At that time, 0.4 feet of subsidence was measured in San Jose. Between 1912 and 1932, over 3 feet of subsidence was measured at the same location. As a result of this drastic increase in subsidence, an extensive leveling network was installed for periodic measuring to evaluate the magnitude and geographical extent of subsidence.

For the purpose of subsidence monitoring, the District's Land Surveying and Mapping Unit surveys the Cross Valley level circuit (which includes the Guadalupe spur) annually each fall. Surveying of the Cross Valley circuit was conducted almost annually from 1960 through 1976, once in 1983, and annually from 1988 to the present. The Alum Rock level circuit has been surveyed semi-annually, in the spring and fall since 1999. These circuits are shown in Figure 4-1. Beginning in 2002, the Land Surveying and Mapping Unit will also survey several South County circuits.

Along these circuits, the District surveys the elevation of benchmarks, which are points of known location and elevation. Land surface elevation can change in response to groundwater pumping, recharge, tectonic activity, or tidal effects. Therefore, the District uses benchmark data in conjunction with groundwater elevations and extensometer data to ensure permanent land subsidence due to groundwater extraction does not exceed the established threshold of 0.01 feet per year.

In 1998, the District entered into a cooperative agreement with the USGS to use Interferometric Synthetic Aperture Radar (InSAR) technology to measure any subsidence that may not have been captured by the existing monitoring program in the North County. This technology compares high-resolution satellite images taken at different times and reveals subtle changes in ground surface elevations with an accuracy of a few millimeters. Data from the study reasonably replicated and supported data from extensometers and the cross valley leveling surveys. One significant finding of the analysis was that for the period studied (1992-97) the basin fluctuated approximately 1.2 inches seasonally between compression and expansion in response to pumping and recharge; in effect, the basin was found to "breathe." The InSAR

images indicated that additional information was needed along the Silver Creek Fault in San Jose, prompting the District to add the Alum Rock circuit in 1999.

In 2001, the Cross Valley level circuit was surveyed in October and the Alum Rock level circuit was surveyed in July and October. Data from 147 benchmarks with continuous record up to the most recent survey of 2001 was used to examine the current condition of land subsidence. The cumulative change in land surface elevation over the period of record for each benchmark (ranging from 3 to 14 years) was computed; the majority of benchmarks (97 out of 147) show an increase in land surface elevation over the continuous period of record. Although some benchmarks showed a decrease in land surface elevation, it should be noted that benchmark elevations may show substantial spatial variation in response to local stresses, such as groundwater pumping, recharge, tectonics, or tidal effects. Also, it can not be determined from benchmark data alone whether any deformation was permanent or elastic. Therefore, the District analyzes benchmark data in conjunction with other data such as groundwater elevations and extensometer data to evaluate whether permanent land subsidence due to groundwater extraction is occurring. Overall, 2001 subsidence monitoring data and groundwater elevations indicate that land subsidence in the Santa Clara Subbasin has been minimized by the District's proactive groundwater management activities.

In addition to using groundwater elevation data, District performance in ensuring "Groundwater supplies are sustained" is also measured using benchmark P7. Benchmark P7 is the location where 13 feet of historical subsidence has been measured since 1912. For the past 10 years the rate of change in land surface elevation at P7 has been stable at negative 0.006 feet per year, indicating the District is exceeding the performance measure of maintaining subsidence rates at less than 0.01 feet per year.

Table 4-1
Predictions Relating Effective Stress and Subsidence (PRESS)
Model Index Well Summary for 2001

PRESS Index Well	Date Measured	2001 Minimum Groundwater Elevation (ft)	Subsidence Threshold Elevation (ft)	Feet Above Subsidence Threshold
1	6/26/01	212.2	166	46.2
2	10/4/01	144.4	-23	167.4
3	NA[1]	NA[1]	-146	NA
Substitute for well 3[2]	9/12/01	64.5	-100	164.5
4	9/13/01	37.3	-18	55.3
5	11/15/01	12.1	-45	57.1
6	8/31/01	44	-47	91
7	NA[1]	NA[1]	-26	NA
8	9/27/01	31.01	-30	61.01
9	9/11/01	-7.2	-35	27.8
10	11/15/01	1.9	-40	41.9

[1] No data available as the original subsidence index well was recently destroyed by the well owner. The District is investigating suitable replacements in the vicinity of these destroyed wells.
[2] As the established subsidence threshold is valid in the immediate vicinity of the original subsidence index well, data from a nearby well with a similar hydrograph is provided.

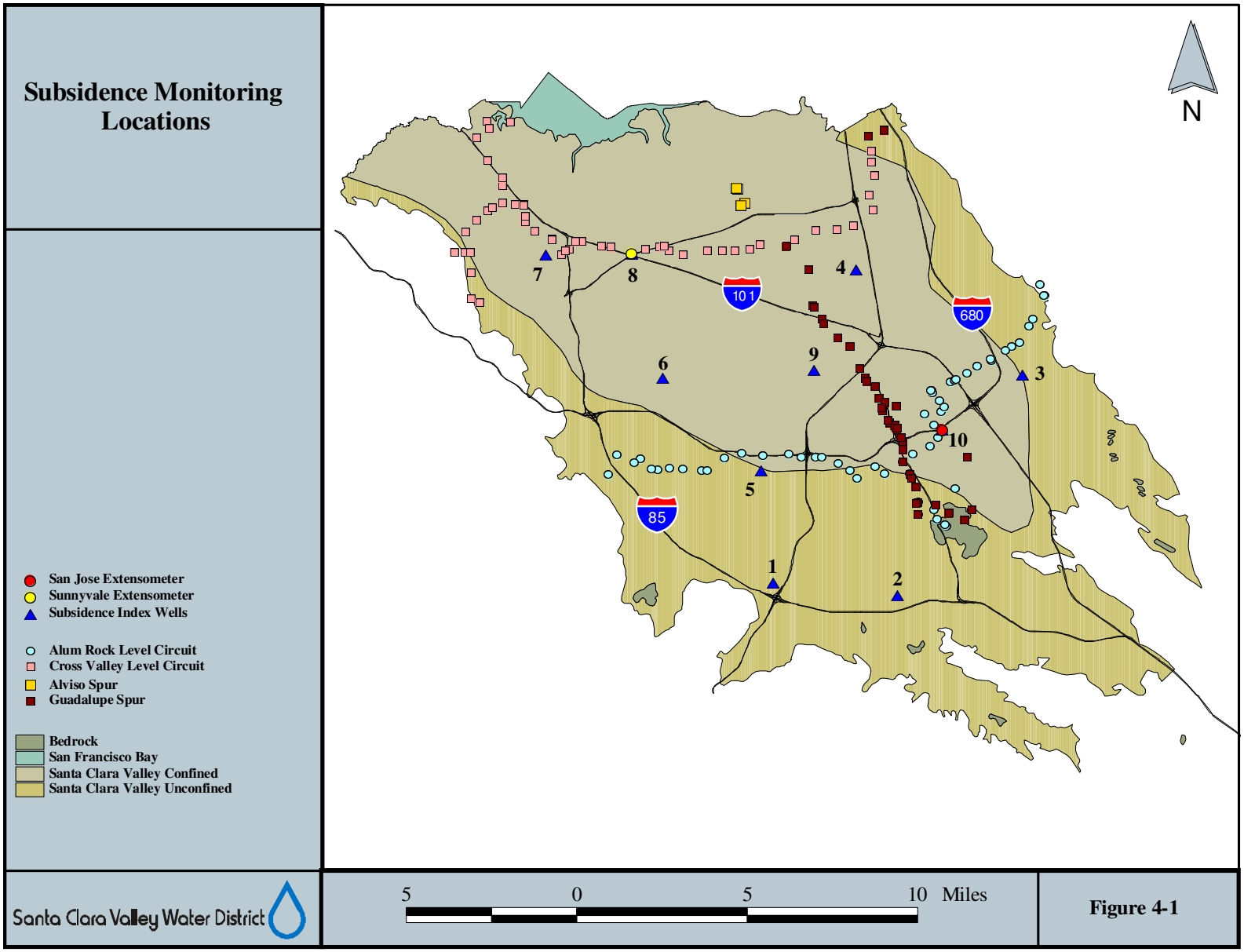
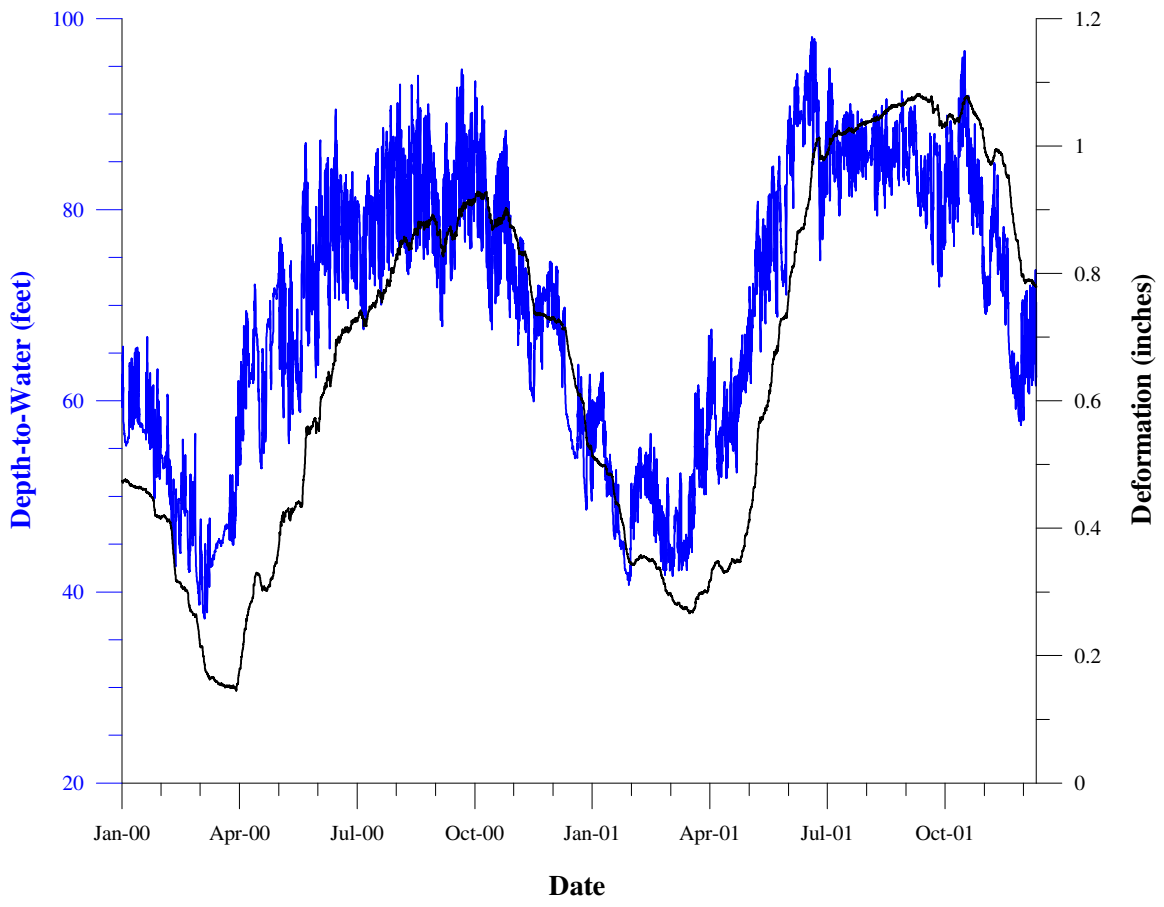

Subsidence Monitoring Locations
San Jose Extensometer
Sunnyvale Extensometer
Subsidence Index Wells
Alum Rock Level Circuit
Cross Valley Level Circuit
Alviso Spur
Guadalupe Spur
Bedrock
San Francisco Bay
Santa Clara Valley Confined
Santa Clara Valley Unconfined
N
101
680
85
1
2
3
4
5
6
7
8
9
10
Santa Clara Valley Water District
5 0 5 10 Miles

Figure 4-1

Stress / Deformation Data from San Jose Extensometer



Hourly Depth-to-Water Measurement (Feet)

Deformation (Inches)

Santa Clara Valley Water District

Figure 4-2

5.0 Groundwater Quality

Groundwater quality is controlled by the amounts and types of dissolved matter present in solution, which are derived from interactions between the atmosphere and rock minerals as rainwater falls to earth and eventually percolates into the subsurface. Certain natural geochemical processes in the aquifer, such as ion exchange, a natural water softening phenomenon, can further modify the dissolved constituent load. Compounds released into the environment by human activities can contribute additional dissolved constituents to the groundwater, such as nutrients from fertilizer, fuels, solvents, and pesticides. The most common dissolved constituents in groundwater are calcium, magnesium, sodium, potassium, bicarbonate, sulfate, and chloride. Other dissolved constituents may include nitrate, metals, other inorganic constituents, or anthropogenic chemicals usually present in much smaller concentration ranges. Certain physical properties are also measures of groundwater quality.

This section describes and discusses the results of general groundwater quality monitoring performed during 2001. The District monitors groundwater quality throughout the groundwater subbasins to assess current conditions, evaluate trends, and identify areas of special concern. Groundwater monitoring also provides data for assessing the suitability of groundwater for beneficial uses. The beneficial groundwater uses defined in the Regional Water Quality Control Board Water Quality Control Plans (Basin Plans) include agricultural, municipal and domestic, industrial process, and industrial supply. Lastly, monitoring results also provide an indication of the effectiveness of various groundwater protection programs conducted by the District and others.

This section describes groundwater quality in principal aquifer zones and upper aquifer zones. Principal aquifer zones are aquifer zones from which most water is pumped for beneficial uses. These aquifer zones are deeper than upper aquifer zones and are typically under confined or semi-confined conditions. The principal aquifers of the basin produce water of very good quality for all designated beneficial uses, including drinking water supply. The upper aquifer zones occur above regional confining layers. Groundwater quality in upper aquifer zones is subject to more contamination from land use activities than the principal aquifer zones. However, groundwater quality in the upper aquifer zones usually meets water quality objectives for all beneficial uses.

A total of 311 wells were sampled by the District and/or public water suppliers in 2001. The District sampled 90 wells, public water suppliers sampled 208 wells, and 13 wells were sampled by both a public water supplier and the District. The samples were analyzed by a California State Department of Health Services (DHS) certified laboratory for general water quality parameters and constituents for which monitoring is required by Title 22 regulations. The locations of the sampled wells are illustrated in Figure 5-1. Of these 311 wells that were sampled, 182 wells were sampled for inorganic constituents other than nitrate, 230 wells were sampled for nitrate, 214 wells were sampled for volatile organic chemicals, 181 wells were sampled for pesticides, and 90 were sampled for radiological constituents. The sampling results are discussed below.

5.1 Inorganic Water Quality

The vast majority of all constituents dissolved in groundwater fall into the inorganic constituent group. Under natural conditions, they are dissolved into solution as essentially pure rainwater percolates into the subsurface and dissolves minerals from rocks and soil into its content. Some of these common constituents are abundant in earthen materials and are soluble in water. Therefore, they typically occur in relatively large concentration ranges. Others are less abundant or are not very soluble in water and these commonly occur only in minute concentrations. The constituents which occur in relatively large concentrations are sometimes referred to as “major constituents” and those which occur in minute

concentrations are termed "minor constituents" or "trace constituents". A few other parameters are commonly included in standard water quality analyses, but do not fit well into either the major or minor constituent groups. For this report, they are grouped into a category called "miscellaneous". The three primary constituent subgroups are itemized below and in Table 5-1:

- Major Constituents: calcium, magnesium, sodium, potassium, bicarbonate, chloride, sulfate, and silica
- Minor Constituents: arsenic, aluminum, barium, bromide, cadmium, chromium, copper, iron, lead, mercury, manganese, nickel, selenium, silver and zinc
- Miscellaneous: total dissolved solids, turbidity, alkalinity, hardness, boron, nitrate and fluoride

Monitoring of these constituents is important because changes in concentration over time signal some kind of unnatural condition, as the composition of the material through which the waters pass remain unchanged. For example, leachate from solid waste landfills contain elevated levels of some major groundwater constituents such as calcium, sodium, magnesium and chloride among others (Freeze and Cherry, 1979). If leachate from a particular landfill was escaping the site and impacting the groundwater system these constituents would become elevated over time. This would signal a manmade contamination condition worthy of special studies and possibly additional regulation or legislation.

The following sections describe mineral characteristics of the water in the groundwater subbasins and the occurrence of specific inorganic constituents of concern. Nitrate in groundwater is discussed separately in Section 5.2 below. Table 5-2 provides typical concentration ranges of common inorganic constituents. Typical concentration ranges are based on a statistical evaluation of the approximate 95 percent confidence interval estimate of the true population median. In other words, the given intervals have an approximate 95 percent probability of containing the true median concentration. This is a more reliable estimate of the true background concentration than using average, mean, or median concentration values from the sampling results (Helsel and Hirsch, 1992).

5.1.1 Mineral Characteristics

The mineral quality of water can be classified based on the predominant cations and anions, the positively and negatively charged ions in the water sample. Major cations include calcium, magnesium, sodium and potassium. Major anions include bicarbonate, chloride, and sulfate. In some wells, nitrate can constitute a significant portion of the total ions. An example of how mineral water quality is classified is as follows: if water is classified as calcium bicarbonate, then calcium constitutes more than 50 percent of the cations, in milliequivalents per liter, and bicarbonate constitutes more than 50 percent of the anions. Water in which no one cation or anion represents more than 50 percent of the total are mixed types and all important cations and anions are identified. Milliequivalents (meq) account for the charge of the different ions and provide a means for comparing the chemical equivalence of the different ions. The cation and anion balance of water samples from the principal aquifers of North County and South County groundwater subbasins are illustrated in Figures 5-2 and 5-3, respectively. The mineral classifications and ratios of different ions provide a means of grouping similar types of water together and highlighting similarities and differences among different water samples.

The mineral character of the groundwater basin is dominated by calcium, magnesium, and bicarbonate. Complete mineral analyses were performed for 116 wells. Of these, 87 wells had calcium bicarbonate, calcium magnesium bicarbonate, or magnesium bicarbonate water types. The remaining wells contained the following water types, in decreasing order of occurrence: mixed cation bicarbonate (13), mixed cation mixed anion (6), sodium chloride (5), sodium bicarbonate (4), and calcium mixed anion (1).

5.1.2 Total Dissolved Solids

Total dissolved solids (TDS), a measurement of the solids dissolved in water, is a primary measurement of water quality. It is not a specific chemical, but a sum of non-evaporative constituents dissolved in water. As water is pumped out of the ground and is put to beneficial use, a large percentage of the water is taken up by plants, evaporates, or is otherwise utilized. However, most of the dissolved solids in the pumped water are not utilized. These dissolved solids, such as salts, are concentrated in the water that returns to groundwater through infiltration. Over time, this process can result in increased TDS concentrations if sufficient natural recharge is not occurring. In addition, specific land or water uses can contribute TDS to groundwater.

Very high concentrations of TDS can cause drinking water to taste salty and make it unusable for some beneficial uses. In addition, high TDS concentrations may indicate that the concentration of one or more dissolved constituents is high and that more detailed water quality analysis is warranted. DHS has established a secondary maximum contaminant level (MCL), or drinking water standard, range for TDS. The range is from 500 milligrams per liter (mg/L) to 1,000 mg/L, though the 500 mg/L concentration is recommended. Concentrations of TDS up to 1,500 mg/L may be permissible on a short-term basis only. It is important to recognize that TDS concentrations in groundwater need to be maintained below the MCL in order to meet beneficial uses and that short-term TDS limits should not be applied to long-term groundwater quality conditions.

Typical TDS concentrations in the primary water supply aquifers of Santa Clara County are below the recommended MCL of 500 mg/L. Concentrations in the upper aquifer zones are higher, with typical concentrations ranging from 490 to 860 mg/L, but still within the drinking water standard range. TDS concentrations only exceeded the drinking water standard in one well. A concentration of 3,900 mg/L TDS was detected in a monitoring well in the upper aquifer zone of the Santa Clara Valley Subbasin, near San Francisco Bay. The drinking water standard for specific conductance, which correlates to TDS concentrations, was exceeded in the same well.

5.1.3 Hardness

Hardness is based on the calcium and magnesium content of water. It is typically reported as the equivalent concentration of calcium carbonate ($CaCO_3$). There is no drinking water standard for hardness, but calcium and magnesium are both necessary nutrients. The most common problems associated with hardness are scaly residues on fixtures and difficulty lathering. Water with hardness (as $CaCO_3$) concentrations less than or equal to 60 mg/L are commonly classified as soft or slightly hard. Waters with hardness (as $CaCO_3$) concentrations between 60 and 180 are moderately hard or hard. Water with a hardness (as $CaCO_3$) concentration above 180 is classified as very hard.

Waters in the Santa Clara County groundwater subbasins are very hard, with typical concentrations ranging from 205 mg/L to 557 mg/L hardness (as $CaCO_3$). Only 12 wells out of 120 wells had hardness values equal to or below 180 mg/L hardness (as $CaCO_3$).

5.1.4 Manganese

Manganese is a naturally occurring constituent in drinking water. The drinking water standard for manganese is 50 micrograms per liter (ug/L). Manganese concentrations above 50 ug/L may cause a black to brown color, black staining, or a bitter metallic taste. Higher concentrations can alter water's taste or smell. However, manganese is not a health concern at the concentrations typically found in groundwater.

Manganese concentrations were generally below the drinking water standard of 50 ug/L, but there were isolated exceedences in 15 wells. Concentrations of manganese above 50 ug/L were detected in seven

wells in the principal aquifer zone of the Santa Clara Valley Subbasin, six wells in the upper aquifer zone of the Santa Clara Valley Subbasin, and two wells in the upper zone of the Llagas Subbasin. All the exceedences in the Santa Clara Valley Subbasin were in the northern third of the confined area. The maximum manganese concentration detected was 1,620 ug/L in the upper zone of the Santa Clara Valley Subbasin near San Francisco Bay. This detection was in the same monitoring well in which the maximum TDS concentration was detected.

5.1.5 Iron

Iron is another naturally occurring constituent in drinking water. The drinking water standard for iron is 300 ug/L. Iron concentrations above 300 ug/L can cause rusty color, sediment, a metallic taste, and reddish or orange staining. Iron is a necessary nutrient and typically concentrations in groundwater are not a health concern.

Iron concentrations were generally below the drinking water standard of 300 ug/L throughout the groundwater subbasins, but there were isolated exceedences in seven wells. Iron concentrations above 300 ug/L were detected in three wells in the principal aquifer zone of the Santa Clara Valley Subbasin, one well in the upper aquifer zone of the Santa Clara Valley Subbasin, one well in the upper aquifer zone of the Llagas Subbasin, and two wells in the principal aquifer zone of the Llagas Subbasin. The maximum iron concentration detected was 12,000 ug/L in the principal aquifer zone of the Santa Clara Valley Subbasin. This result is anomalous compared to previous results and will be re-evaluated with subsequent analyses.

5.1.6 Chloride

Many coastal groundwater basins experience some form of seawater encroachment into fresh water aquifers. Under natural conditions in Santa Clara County, seaward hydraulic gradients hold the high chloride waters at bay, limiting the impact. However, as water demands and pumping increase, hydraulic gradients can change from seaward to landward and high chloride waters can be drawn into fresh water aquifers. Monitoring for this condition is very important as a severe case of seawater intrusion can render fresh water aquifers useless for just about all beneficial uses.

A zone of saltwater intrusion has been observed along San Francisco Bay, in the northern portion of the Santa Clara Valley Subbasin. The extent of intrusion is defined by the 100 mg/L chloride isoconcentration contour illustrated in Figure 5-4. This area encompasses approximately 18 square miles of the upper aquifer zone along San Francisco Bay and the salt evaporation ponds, from Highway 101 on the west to Highway 880 on the east. Intrusion extends as much as three miles landward from the salt evaporation ponds along the Guadalupe River.

The District has been monitoring saltwater intrusion since the early 1980s. At present, the area affected by saltwater intrusion appears to be stable. Statistical analysis of quarterly monitoring data from the period from 1998 to 2001 showed evidence of a downward trend in several wells, while no evidence of a trend was observed in the remaining wells. In addition, little difference can be observed in the location of the 100 mg/L chloride isoconcentration contour from 1985 reports to the current contour. The stability of saltwater intrusion is attributed to the District's groundwater management programs, which have been successful at minimizing land subsidence that leads to saltwater intrusion, and to District programs to destroy abandoned wells that may transmit contaminated waters from one aquifer zone to another.

The drinking water standard for chloride is 600 mg/L and the agricultural water quality objective is 355 mg/L. High chloride concentrations in drinking water can impart a salty taste. High chloride concentrations in irrigation water can damage some plants. Chloride concentrations above 355 mg/L were only detected in two wells, both of which are in the Santa Clara Valley Subbasin. One of these

wells is an upper zone well in the area of known saltwater intrusion. The other well is in the principal aquifer zone in Palo Alto area. This is one of the areas where sodium chloride waters were encountered. The water type could be attributed to inter-aquifer transfer of intruded seawater or deep saline connate water.

5.1.7 Boron

Boron is a naturally occurring inorganic constituent found in groundwater, usually at low concentrations. While boron in drinking water does not pose a known human health hazard, it is toxic to some plants at higher concentrations. The agricultural water quality objective for boron is 200 ug/L. Boron concentrations in most wells were below the agricultural objective, but there were 15 isolated exceedences. Boron concentrations above 200 ug/L were detected in eight wells in the principal aquifer zone of the Santa Clara Valley Subbasin, six wells in the upper zone of the Santa Clara Valley Subbasin, and one well in the upper aquifer zone of the Llagas Subbasin. None of the wells in which boron was detected above 200 ug/L are used for agricultural water supply.

5.1.8 Fluoride

Fluoride is another naturally occurring inorganic constituent, though fluoride concentrations are usually less than 1 mg/L. The drinking water standard for fluoride is 1.7 mg/L, to protect against dental fluorosis, a mottling of the teeth in children. Higher fluoride concentrations can also lead to bone disease in adults. It should be noted that, while there is a MCL for fluoride, many water systems add small amounts of fluoride to their water supply to provide protection against dental cavities. The fluoride standard was exceeded in one well. This well, located in the principal aquifer of the Santa Clara Valley, contained a fluoride concentration of 3.2 mg/L.

5.1.9 Turbidity

Turbidity is a measurement of the clarity of drinking water. The drinking water standard for turbidity is 5 Nephelometric Turbidity Units (NTU). This is a secondary standard related to the appearance of the water. The turbidity standard was exceeded in five wells, with a maximum turbidity of 21 NTU. Two of these wells are monitoring wells. The remaining wells are public water supply wells, though two of them are inactive. The turbidity in the one active public water supply well was 5.5 NTU, which is low and very close to the MCL.

5.1.10 Other Inorganic Constituents

Other inorganic constituents, including arsenic and chromium, were not detected above their drinking water standards, nor were they detected in concentrations in excess of what would be considered as naturally occurring.

5.2 Nitrate

Nitrate in the environment comes from both natural and anthropogenic sources. Naturally-occurring nitrate is formed in soil by bacteria and in the atmosphere by lightning. Anthropogenic nitrate is formed by fossil fuel combustion and the manufacturing of fertilizers. Nitrate is very soluble in water, so it is readily dissolved in rainfall or irrigation water that infiltrates to groundwater. In addition, nitrate is stable in most groundwater systems. Other forms of nitrogen that can occur in the groundwater environment are nitrite, ammonium, ammonia, and nitrogen gas. Small amounts of nitrate in groundwater (less than 10 mg/L) are normal, but higher concentrations indicate contamination. Common sources of nitrate in groundwater are fertilizers, septic systems, and animal waste. Wastewater discharges from food processing plants and recycled water can also contain high nitrate concentrations. The drinking water standard for nitrate is 45 mg/L as nitrate. This standard is based on protecting infants, who are susceptible to health effects from nitrate in drinking water. Since the Santa Clara Valley has a long

history of agricultural production and septic systems are still in use in the unincorporated areas of the county, monitoring for nitrate contamination is an essential groundwater management function in this valley.

The typical nitrate concentration range for the principal aquifer of the Santa Clara Valley Subbasin is 12 to 16 mg/L, indicating that anthropogenic contamination is present. The maximum nitrate concentration detected in this zone was 39 mg/L. While nitrate concentrations were below the drinking water standard, public water suppliers have reported increasing and/or high concentrations in some of their wells.

Nitrate concentrations in the upper aquifer zone of the Santa Clara Valley Subbasin are typically less than 10 mg/L. District staff concludes that the higher nitrate concentrations in the principal aquifer zone are the result of historic nitrate sources, rather than ongoing nitrate sources. If ongoing nitrate sources were contributing to nitrate concentrations, then nitrate concentrations in the upper aquifer zone would likely be higher than they currently are.

The typical nitrate concentration range for the Coyote Subbasin is 10 to 47 mg/L. About one-third of the wells (6 of 16) contained nitrate concentrations in excess of the drinking water standard and nitrate concentrations were elevated in the remaining wells. The wells with nitrate concentrations above the drinking water standard are located in the southern half of the subbasin. The primary land uses in the subbasin are agricultural and rural residential.

The typical nitrate concentration range for the upper aquifer zone of the Llagas Subbasin is 38 to 51 mg/L. The typical nitrate concentration range for the principal aquifer zone is 29 to 37 mg/L. The data indicate anthropogenic contamination in both aquifer zones. In the principle aquifer zone, 23 of 75 wells contained nitrate concentrations above the drinking water standard, and 11 of 15 wells in the upper aquifer zone contained nitrate concentrations above the drinking water standard. Current land uses in the subbasin are varied, with urban areas in the cities of Gilroy and Morgan Hill and rural areas in the remainder of the subbasin.

In 2001, the drinking water standard for nitrate was exceeded in more wells than any other constituent and elevated nitrate concentrations were observed throughout the groundwater basin. Figure 5-5 shows the relative nitrate concentrations in the principle aquifer zones of the groundwater basin. The District began implementing a nitrate management program in 1992. The program was first implemented to address increasing nitrate concentrations in the Llagas Subbasin, but has since been expanded countywide. The current program consists of nitrate monitoring, and efforts to reduce exposure and to reduce nitrate loading. Staff is also researching options for reducing nitrate concentrations in groundwater, including groundwater treatment and increasing recharge with low nitrate surface water.

5.2.1 Nitrate Monitoring

The District began monitoring nitrate in the Coyote and Llagas Subbasins in February 1999. Samples are collected from a total of approximately 55 wells. Wells in both the upper and principal aquifer zones are included in the monitoring program. In 2001, staff completed a statistical evaluation of the data collected between February 1999 and March 2001 to determine if there were concentration trends in the wells. A decreasing trend was observed in 12 of the wells, an increasing trend was observed in 2 wells, and no evidence of trend either way was observed in the remaining wells.

Staff also evaluated the quarterly nitrate data for concentration differences between quarters. Significant quarterly differences were not observed. Staff has since reduced the sampling frequency to biannually, in April and October.

Staff also performed a statistical comparison of nitrate concentrations in 1988 to concentrations in 1998. In 1988, the County of Santa Clara performed an extensive well water testing program for nitrate, which included sampling over 450 wells. The District performed a similar testing program in 1998, in which over 600 wells were tested. The difference in median nitrate concentrations in the Coyote Subbasin was statistically insignificant. However, the difference in the Llagas Subbasin was statistically significant, with the median concentration increasing from 41 mg/L to 47.1 mg/L.

A study is underway to evaluate nitrate occurrence and trends in the principal aquifer zone of the Santa Clara Valley Subbasin. This study is in response to public water supplier concerns about high concentrations in some wells.

5.2.2 Nitrate Exposure

To reduce exposure to nitrate, the District offers a free nitrate analysis to all private water supply well users. Since 1998, over 600 tests have been conducted. More than half the wells tested have exceeded the MCL of 45 mg/L. Test recipients are given a copy of the results along with a fact sheet detailing what nitrate is, where it comes from, what the health risks are, how to remove nitrate using point of use treatment systems, and how to prevent groundwater contamination.

5.2.3 Nitrate Loading

The District conducts public outreach and education, and works with other agencies to reduce nitrate loading from a number of sources. The main sources of nitrate loading are fertilizers, animal waste, and septic systems. Waste discharges from food processing plants and recycled water can also contribute nitrate to groundwater.

Outreach and education activities include:

- Preparing and distributing fact sheets on irrigation and nutrient management, wells, and septic systems
- Conducting seminars and workshops irrigation and nutrient management and groundwater protection at horse and rural residential properties
- Providing one-on-one technical assistance on irrigation and nutrient management to growers

Staff also coordinates with other agencies, including the Regional Water Quality Control Boards (Regional Boards) and Santa Clara County Department of Environmental Health, to provide input on implementing their regulations to protect local groundwater resources. These agencies are involved in regulating septic systems and wastewater discharges.

5.3 Volatile Organic Chemicals

Volatile organic chemicals (VOCs) are used in a variety of commercial, industrial, and manufacturing activities, including gasoline stations, circuit board manufacturing, dry cleaning, semiconductor manufacturing, automotive repair, and numerous others. While they rarely constitute a significant mass of the total dissolved solids due to solubility limitations, some can cause serious health effects at very low concentrations. Organic substances most commonly affect shallow upper aquifer zones and originate from improper disposal practices, releases from underground storage tanks, or from accidental spills or leaks. Monitoring for volatile organic contamination is crucial, because widespread contamination at even low concentrations could drastically limit groundwater basin use. The VOCs with drinking water standards or for which monitoring is required by DHS regulations are listed in Table 5-1. Analyses of additional VOCs, those typically reported with approved drinking water analytical methods, were

performed by the District and public water suppliers. Staff reviewed the results of all VOC analyses and the results are discussed below.

The VOC monitoring results discussed here are based on samples collected by the District as part of its basinwide groundwater monitoring program or by public water suppliers as part of their Title 22 compliance monitoring, unless otherwise noted. Groundwater monitoring for VOCs is also routinely performed at contamination sites. However, that site-specific data is not reported here, as it is too voluminous and does not reflect basinwide groundwater quality conditions.

The only VOC that was detected above drinking water standards was methyl tertiary butyl ether (MTBE), which was detected in two upper zone monitoring wells in the Llagas Subbasin. The detected concentrations were 5.2 and 5.3 ug/L. The secondary drinking water standard, based on protecting consumers from tastes and odors, is 5 ug/L. The primary drinking water standard, based on protecting consumers from adverse health effects, is 13 ug/L. Only the secondary standard for MTBE was exceeded.

VOCs below drinking water standards were detectable in a total of 31 wells. Four of these wells were upper zone monitoring wells in the Llagas Subbasin. The remaining 27 wells are active water supply wells in the principal aquifer zones, with 3 in the Llagas Subbasin and 24 in the Santa Clara Valley Subbasin. The most commonly detected VOCs were 1,1,1-trichloroethane, which was detected in 15 wells, and trihalomethanes (THMs), which were detected in eight wells. A summary of VOC detections is provided in Table 5-3.

During the summer and fall of 2001, the District assisted the State Water Resources Control Board in conducting a groundwater sampling project in the Santa Clara Valley Subbasin. The project, called the California Aquifer Susceptibility (CAS) Assessment Project, involved sampling 58 public water supply wells for VOCs using very low-level detection limits. The detection limits range from 0.005 ug/L to 0.066 ug/L, rather than the normal 0.5 ug/L detection limit. VOCs were detected during this project in a number of wells. The most commonly detected chemicals were MTBE, THMs, and tetrachloroethylene. The sampling results are summarized in Table 5-4 and illustrated in Figure 5-6.

Although all VOC detections, with the exception of the MTBE detections, were below drinking water standards, VOCs are still a concern. VOC detections in the principal aquifer zones indicate that VOC contamination has migrated from surface and near surface sources to deeper water supply aquifers, indicating a migration pathway for contamination to move into the principal aquifers. The method by which this movement has occurred needs to be evaluated. On the other hand, low concentrations and relatively few detections indicate that the regulatory programs designed to ensure VOC contamination sites are properly investigated and cleaned up have, for the most part, been successful in protecting the groundwater subbasins from contamination. These programs are described below.

5.3.1 Solvents and Toxics Liaison Program

The District conducts the Solvents and Toxics Liaison Program, which addresses VOC and other types of toxic contamination. The high density of dry cleaners and electronics manufacturing plants in some parts of Santa Clara County, together with heavy industry and military facilities, has resulted in several hundred VOC release sites impacting shallow groundwater. The District provides peer review and tracks the progress of these sites, and sites with other toxic releases, to ensure that water resources are protected. To date, over 700 solvents and toxic sites have been reported in the county. There are approximately 200 active cases, 200 inactive cases, 200 closed cases, and 100 other status type cases. A summary of attributes for the groundwater contamination plumes at the active sites is summarized in Table 5-5. Most of the significant groundwater contamination plumes are illustrated in Figure 5-7.

The District is continuing to monitor progress at active sites and is working with the regulatory agencies to resolve the inactive and other status type cases. Staff is also performing a study of the historic locations of dry cleaners in Santa Clara County to determine how many potential sources of dry cleaner contamination are present in the basin, and to rank them with respect to their potential to degrade groundwater quality.

5.3.2 Leaking Underground Storage Tank Oversight Program

The District also oversees the investigation, cleanup, and closure of cases where soil and/or groundwater have been affected by petroleum fuel and additives such as MTBE from leaking underground storage tank (UST) systems. More than 2,340 leaking UST cases have been reported in the county. Seventy-five percent of these cases have been closed, but investigation and cleanup activities are ongoing at more than 500 active cases. Groundwater has been impacted at nearly all the active cases (87 percent) and MTBE has been detected at about 75 percent of those cases. Most of the contamination associated with these sites has been limited to the upper aquifer zone. However, MTBE contamination has caused impacts in two public water supply wells. In addition, MTBE was detected in the part per trillion range in 26 wells that were sampled last summer as part of the CAS Assessment project.

MTBE is an ongoing concern for the District. Field studies performed by the District and others show that undetected releases continue to occur at up to 60 percent of operating gasoline tank facilities. In March 2002, the Governor extended the phase-out date for MTBE to 2004, which will allow for another year of undetected releases. Staff will continue to provide vigilant oversight to leaking UST sites and communicate information about the ongoing threat to groundwater resources from MTBE in gasoline.

5.4 Synthetic Organic Chemicals

Non-volatile synthetic organic chemicals (SOCs) include pesticides, dioxin, polychlorinated biphenyls (PCBs), and chemical manufacturing discharges. Pesticides are designed to be poisonous to one or more organisms, and many pose a threat to human health. Most pesticides currently permitted for use in California break down quickly in the environment and/or pose a low risk to human health and the environment. However, some toxic and more mobile pesticides are still in use. In addition, toxic and persistent pesticides used historically may still be present in the environment. The California Department of Pesticide Regulation has groundwater protection regulations and monitors groundwater throughout the state for pesticides. In addition, public water suppliers are required to monitor for pesticides. Other SOCs of concern, most notably dioxin and PCBs, are also very toxic. Dioxin has a drinking water standard of 0.00003 ug/L.

Public water suppliers sampled 55 wells for one or more SOCs during 2001. The SOCs with a drinking water standard are listed in Table 5-1. Analyses for some SOCs without a drinking water standard were also performed in some wells, but these SOCs are not listed in Table 5-1. The results of all SOC analyses were nondetectable.

5.5 Radiological Constituents

Gross alpha particle activity is a measure of natural radioactivity. No wells were out of compliance for radiological constituents. However, gross alpha particle activity exceeded the drinking water standard of 15 picocuries per liter in one sample from one public water supply well. However, compliance with the drinking water standard for natural radiological constituents is based on the average analytical results of four consecutive quarters. The average analytical result for the subject well is 8.91 picocuries per liter.

5.6 Groundwater Quality Summary

Overall groundwater quality in Santa Clara County is very good and water quality objectives are met in almost all wells. The most significant exception is nitrate, which continues to be a problem in the Llagas and Coyote Subbasins. The nitrate drinking water standard was exceeded in 40 wells. Some of these are upper zone monitoring wells and others are agricultural supply wells. However, the drinking water standard for nitrate was exceeded in 22 wells whose primary use is municipal or domestic supply. The District is continuing to implement a comprehensive nitrate management program to reduce nitrate exposure, reduce nitrate loading, and monitor groundwater quality.

Drinking water standards for other inorganic constituents were exceeded in 20 wells. However, all these exceedences were for naturally occurring constituents and all but one of the exceedences was for a secondary drinking water standard. Secondary standards are based on protecting consumers from adverse tastes, odors, or appearance. Such exceedences do not pose a health risk. One well contained fluoride concentrations in excess of the primary, or health-based, drinking water standard. The agricultural water quality objective for boron was exceeded in 15 wells, but none of those wells is used for agricultural supply.

MTBE was detected just above the secondary drinking water standard of 5 ug/L in two upper aquifer zone monitoring wells. There were no MTBE detections above the primary drinking water standard. Other VOCs were detected below drinking water standards in 29 wells. The District's Solvent and Toxics Program Liaison and Leaking Underground Storage Tank Oversight Program are ongoing programs designed to protect groundwater resources from VOC contamination.

SOCs were nondetectable in all the samples collected.

The drinking water standard for gross alpha particle activity, an indicator of natural radioactivity, was exceeded in one well. However, the average measurement of four consecutive quarters, on which compliance is based, was well below the standard.

District Board Ends Policy directs staff to ensure "The groundwater basins are aggressively protected from contamination and the threat of contamination." The Chief Executive Officer's interpretation of this policy is that drinking water standards for anthropogenic constituents should not be exceeded in water supply wells. The data summarized in this report shows that, for the most part, groundwater management programs achieve the desired end. The nitrate standard was the only drinking water standard for an anthropogenic constituent that was exceeded in drinking water supply wells and it was exceeded in a very small percentage of wells. The District continues to implement a comprehensive nitrate management program to monitor nitrate occurrence, reduce consumer exposure to nitrate in drinking water, and reduce nitrate loading throughout the basin. The goal of the nitrate management program is to reduce nitrate concentrations in groundwater so that all wells meet the drinking water standard for nitrate.

The District will continue monitoring groundwater quality and collecting public water supply well data from DHS.

Table 5-1
Groundwater Constituents Sampled in 2001

Inorganic Constituent Group (including nitrate)		
Alkalinity	Chromium	Nitrate
Aluminum	Copper	Potassium
Arsenic	Fluoride	Selenium
Barium	Hardness	Silica
Bicarbonate	Iron	Silver
Boron	Lead	Sodium
Bromide	Magnesium	Sulfate
Cadmium	Manganese	Total Dissolved Solids
Calcium	Mercury	Turbidity
Chloride	Nickel	Zinc
Volatile Organic Chemicals (VOCs)		
Benzene	trans-1,2-Dichloroethylene	Tetrachloroethylene
Bromodichloromethane (THM)	Dichloromethane	Toluene
Bromoform (THM)	1,2-Dichloropropane	Total Trihalomethanes (TTHMs)
Carbon Tetrachloride	1,3-Dichloropropene	1,2,4-Trichlorobenzene
Chloroform (THM)	Ethyl tertiary butyl ether	1,1,1-Trichloroethane
Dibromochloromethane (THM)	Ethylbenzene	1,1,2-Trichloroethane
1,2-Dichlorobenzene	Methyl tertiary butyl ether	Trichloroethylene
1,4-Dichlorobenzene	Monochlorobenzene	Trichlorofluoromethane
Dichlorodifluoromethane	Styrene	1,2,3-Trichloropropane
1,1-Dichloroethane	Tertiary amyl methyl ether	1,1,2-Trichloro-1,2,2-Trifluoroethane
1,2-Dichloroethane	Tertiary butyl alcohol	Vinyl Chloride
1,1-Dichloroethylene	1,1,2,2-Tetrachloroethane	Xylenes (Total)
cis-1,2-Dichloroethylene		
Synthetic Organic Chemicals (SOCs)		
Alachlor	Dinoseb	Methoxychlor
Atrazine	Diquat	Molinate
Bentazon	Endothall	Oxamyl
Benzo(a)pyrene	Endrin	Pentachlorophenol
Carbofuran	Ethylene Dibromide (EDB)	Picloram
Chlordane	Glyphosate	Polychlorinated Biphenyls
2,4-D	Heptachlor	Simazine
Dalapon	Heptachlor Epoxide	Thiobencarb
Dibromochloropropane (DBCP)	Hexachlorobenzene	Toxaphene
Di(2-ethylhexyl)adipate	Hexachlorocyclopentadiene	2,3,7,8-TCDD (Dioxin)
Di(2-ethylhexyl)phthalate	Lindane	2,4,5-TP (Silvex)

Table 5-2
Typical Concentration Ranges for Common Inorganic Constituents[a]

Constituent	Santa Clara Valley Subbasin		Coyote Subbasin	Llagas Subbasin		Drinking Water Standard[e]	Agricultural Objective[f]
	Principal Aquifer Zone[c]	Upper Aquifer Zone[d]	Principal Aquifer Zone[c]	Principal Aquifer Zone[c]	Upper Aquifer Zone[d]		
Aluminum (ug/L)	<50	<50	<50	<50	<100	1,000	5,000
Arsenic (ug/L)	<2	<2	<2	<2	<2	50	200
Barium (ug/L)	100-130	<240	<126	<140	<260	1,000	-
Beryllium (ug/L)	<1	<1	<1	<1	<1	4	500
Boron (ug/L)	120-140	144-264	<132	<169	120-194	-	200
Bromide (ug/L)	0.11-0.18	0.17-0.46	0.09-0.16	0.15-0.31	0.12-0.32	-	-
Cadmium (ug/L)	<1	<1	<1	<1	<1	5	50
Calcium (mg/L)	54-67	67-109	28-56	46-57	51-98	-	-
Chloride (mg/L)	37-47	56-107	27-35	34-51	30-143	600	355
Chromium, Total (ug/L)	<10	<10	<12	<10	<10	50	1,000
Copper (ug/L)	<50	<50	<50	<50	<50	1,000	500
Fluoride (mg/L)	0.15-0.19	<0.18	0.14-0.21	0.12-0.21	0.12-0.19	1.7	2
Hardness (mg/L as $CaCO_3$)	240-298	373-555	205-330	230-270	232-557	-	-
Iron (ug/L)[b]	<10	<67	<5	<100	<230	300	20,000
Lead (ug/L)	<5	<5	<5	<5	<5	15	100
Magnesium (mg/L)	24-34	34-70	24-60	25-39	24-69	-	-
Manganese (ug/L)	<20	<538	<20	<20	<90	50	10,000
Mercury (ug/L)	<1	<1	<1	<1	<1	2	-
Nickel (ug/L)	<10	<10	<10	<10	<10	100	2,000
Nitrate (mg/L as NO_3)	12-16	<9	10-47	29-37	38-51	45	135[g]
Selenium (ug/L)	<5	<5	<5	<5	<5	50	20
Silver (ug/L)	<10	<10	<10	<10	<10	100	-
Sodium (mg/L)	30-37	43-154	22-28	19-30	15-74	-	-
Specific Conductance (uS/cm)	570-622	721-1360	373-680	520-640	576-1160	2,200	3,000
Sulfate (mg/L)	39-48	35-231	31-52	30-43	32-145	600	-
Total Dissolved Solids (mg/L)	380-420	520-860	330-400	330-370	490-780	1,500	10,000
Zinc (ug/L)	<50	<50	<50	<66	<50	5,000	10,000

Table 5-2
Typical Concentration Ranges for Common Inorganic Constituents
Legend

[a] Typical concentration ranges at the approximate 95% Confidence Interval estimate of the true population median.
[b] The detection limit for iron varied from 5 ug/L to 100 ug/L, which is why the lower end of the typical concentration ranges vary.
[c] Principal Aquifer Zone: Aquifer zone from which most water supply wells pump.
[d] Upper Aquifer Zone: Shallow aquifer zone above the regional confining layer in the Santa Clara Valley and Llagas Subbasins.
[e] Drinking Water Standard: Maximum Contaminant Level (MCL) specified in Title 22 of the California Code of Regulations.
[f] Agricultural Objective: Agricultural water quality objective in the 1995 Water Quality Control Plan for the San Francisco Bay Basin, Regional Water Quality Control Board.
[g]Nitrate Agricultural Objective: The value listed in the Basin Plan is 30 mg/L NO3+NO2 (as N), which is approximately equivalent to 135 mg/L nitrate as nitrate.

Table 5-3
Volatile Organic Chemical (VOC) Detections

Chemical	Number of Wells with Detections	Maximum Concentration Detected (ug/L)	Drinking Water Standard (ug/L)
1,1,1-Trichloroethane	15	4.4	200
Trihalomethanes	8	44	100
Dichloromethane	4	2.5	5
Dichlorodifluoromethane	3	160	1000[1]
Methyl Tertiary Butyl Ether	2	5.3	5/13[2]
1,1-Dichloroethylene	2	1.6	6
Tetrachloroethylene	2	1.7	5
1,4-Dichlorobenzene	1	0.58	5
1,1,2-Trichloro-1,2,2-Trifluorothane	1	26	1,200

[1] Dichlorodifluoromethane is an unregulated chemical for which monitoring is required. It does not have a drinking water standard at this time. The value listed, 1000 ug/L, is the action level. Action levels are health-based advisory levels.
[2] The secondary, aesthetically-based drinking water standard is 5 ug/L. The primary, health-based standard is 13 ug/L.

Table 5-4
California Aquifer Susceptibility (CAS) Assessment Results Summary

Chemical	Detection Limit (ug/L)	Number of Wells with Detections	Maximum Concentration Detected (ug/L)	Drinking Water Standard (ug/L)
Methyl tertiary butyl ether	0.005	26	0.069	5
Trihalomethanes	0.005	25	1.096	100
Tetrachloroethylene	0.005	10	0.118	5
Xylenes (Total)	0.005	5	0.006	1,750
Trichloroethylene	0.005	5	0.133	5
Toluene	0.005	4	0.087	150
1,1,2-Trichlor-1,2,2-Trifluoroethane	0.060	2	1.081	1,200
1,1,1-Trichloroethane	0.032	2	3.502	200
Ethylbenzene	0.005	1	0.005	700
1,1-Dichloroethane	0.066	1	0.044	5
1,1-Dichloroethylene	0.040	1	0.436	6
Benzene	0.005	0	Not Applicable	1

Table 5-5
Summary of Active Solvent and Toxics Cases

Attribute	Maxiumum	Median	Notes
Plume Length	7,610 feet	825 feet	
Plume Depth	364 feet below ground surface (bgs)	40 feet bgs	Approximate
Plume Area	350 acres	8.2 acres	Area enclosed by MCL contour
Historical Maximum Total VOC Concentration	8,329 mg/L	29 mg/L	Compares site maxima; not representative of entire plume
August 2000 Maximum Total VOC Concentration	352 mg/L	1.48 mg/L	Compares site maxima; not representative of entire plume
Most Prevalent Contaminant	Historical: trichloroethene	Current: trichloroethene	
Rate of Groundwater Extraction in Pump & Treat	743 gallons per minute	18.25 gallons per minute	Total: About 90 acre-feet/day
Mass Contaminant Removed by Pump & Treat	Maximum Pounds of Total VOCs per year: 2,132	Median Pounds of Total VOCs per year: 32	Percentage reduction in median total VOC from maximum historical to August 2000: **95%**

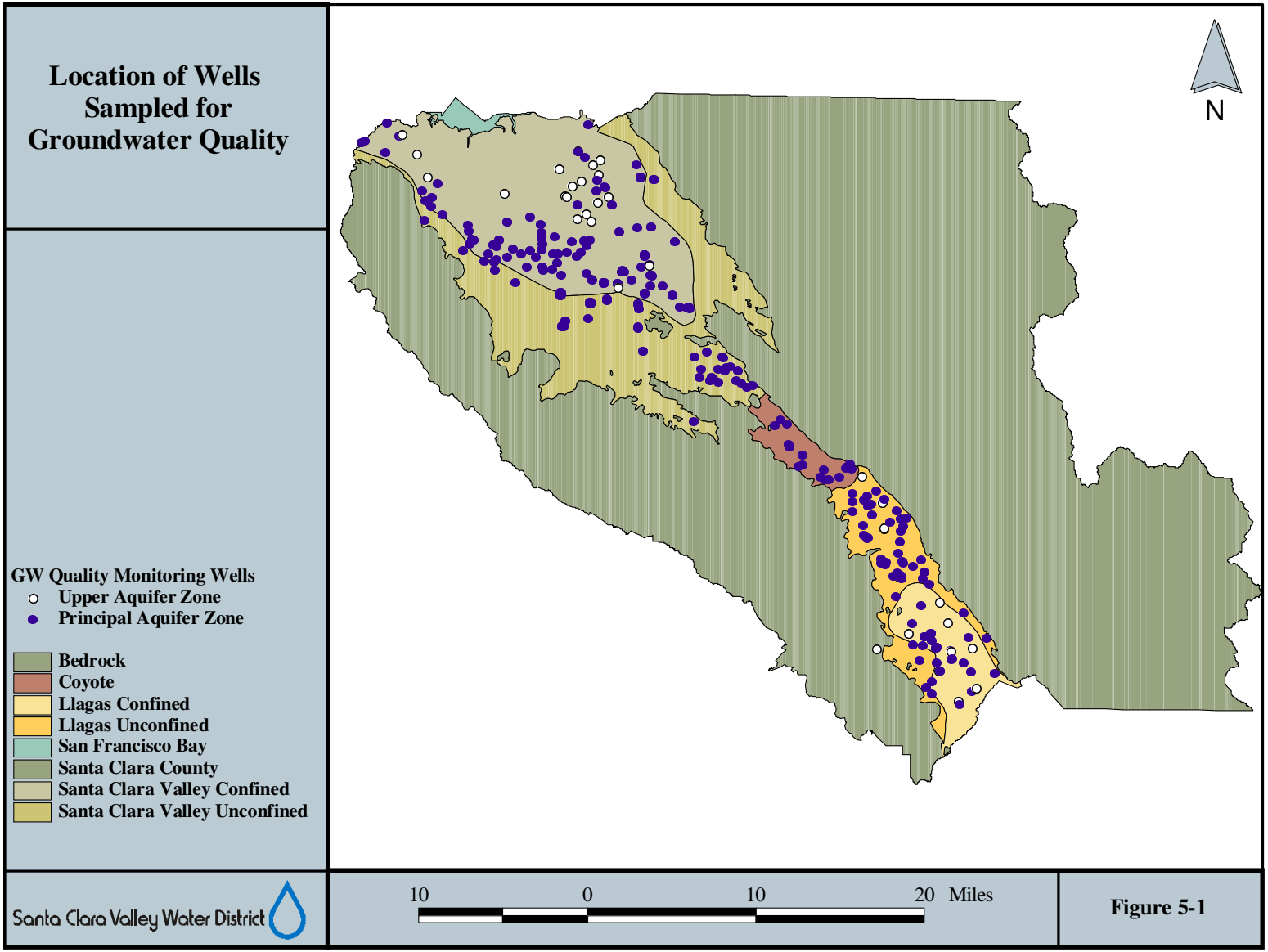
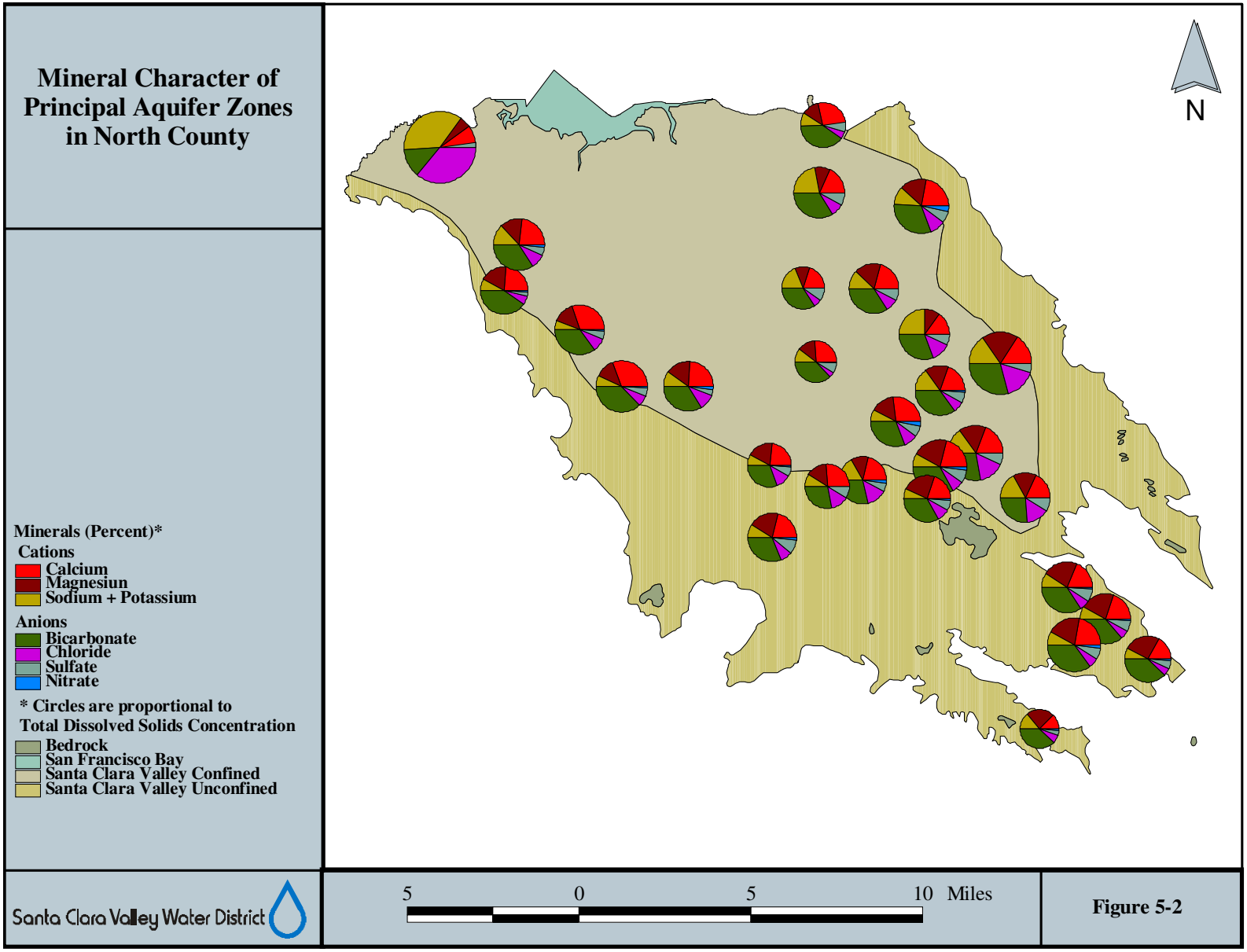

Location of Wells Sampled for Groundwater Quality
GW Quality Monitoring Wells
Upper Aquifer Zone
Principal Aquifer Zone
Bedrock
Coyote
Llagas Confined
Llagas Unconfined
San Francisco Bay
Santa Clara County
Santa Clara Valley Confined
Santa Clara Valley Unconfined
N
Santa Clara Valley Water District
10 0 10 20 Miles

Figure 5-1


Mineral Character of Principal Aquifer Zones in North County
N
Minerals (Percent)*
Cations
Calcium
Magnesiun
Sodium + Potassium
Anions
Bicarbonate
Chloride
Sulfate
Nitrate
* Circles are proportional to Total Dissolved Solids Concentration
Bedrock
San Francisco Bay
Santa Clara Valley Confined
Santa Clara Valley Unconfined
Santa Clara Valley Water District
5 0 5 10 Miles
Figure 5-2

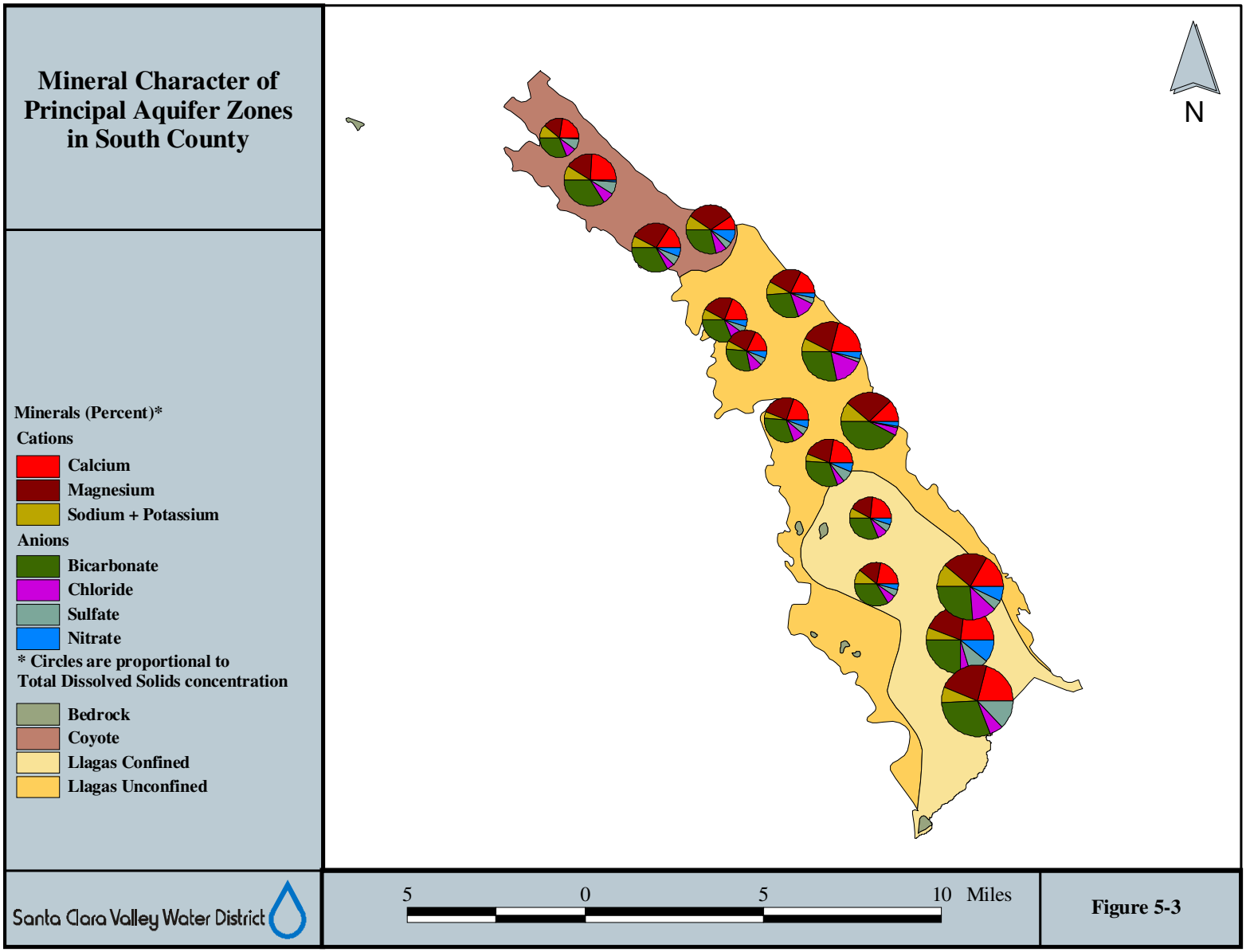
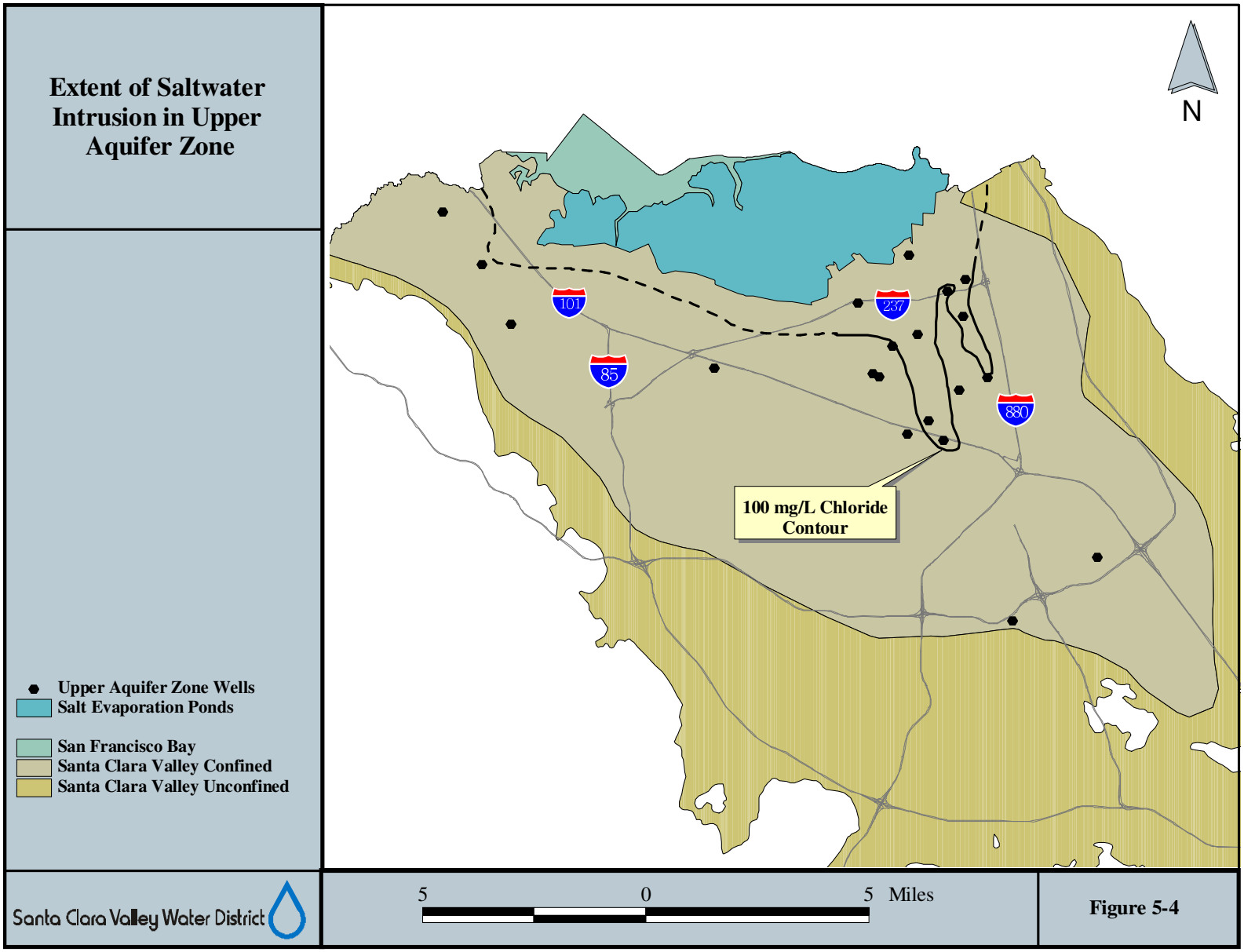
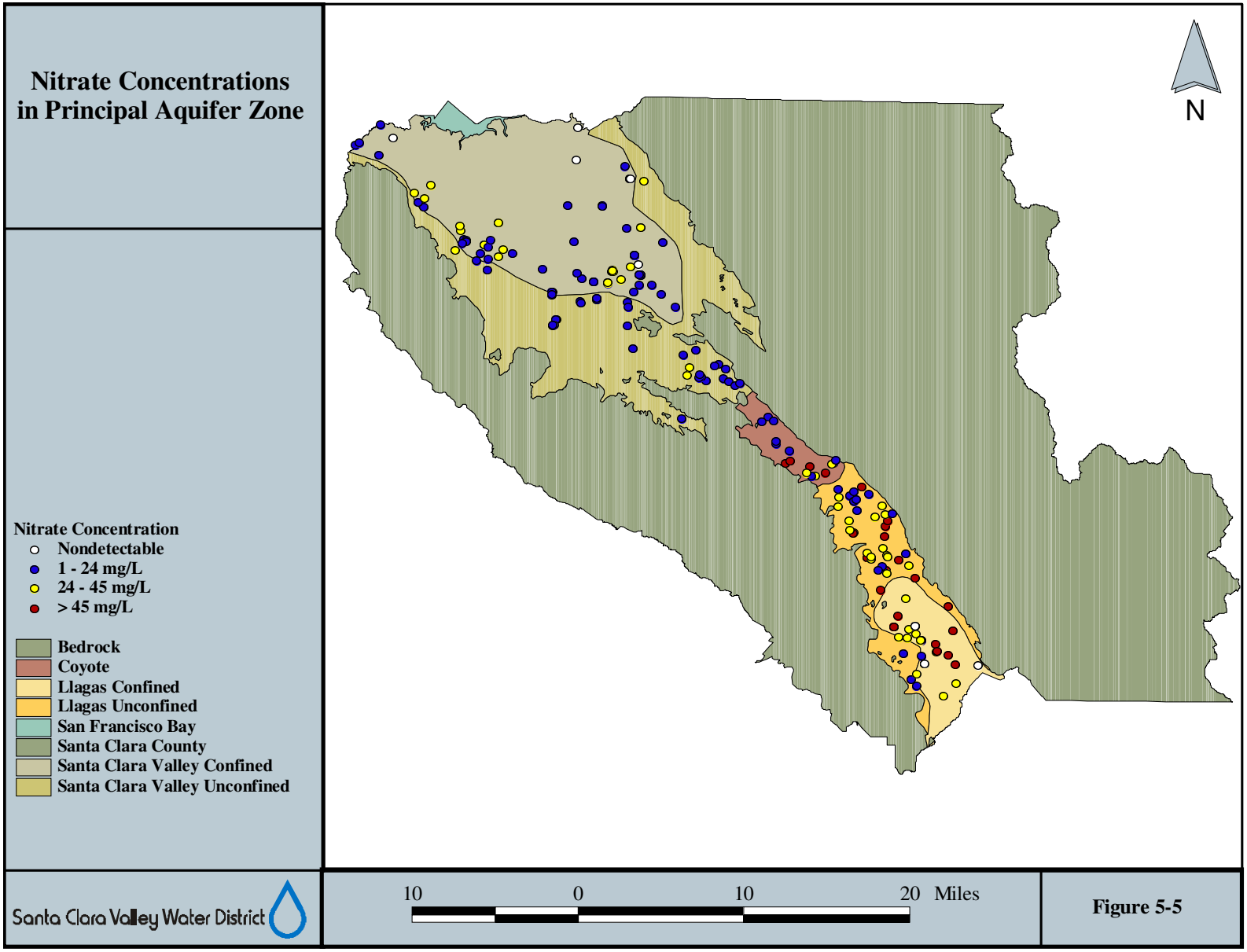

Mineral Character of Principal Aquifer Zones in South County
Minerals (Percent)*
Cations
Calcium
Magnesium
Sodium + Potassium
Anions
Bicarbonate
Chloride
Sulfate
Nitrate
* Circles are proportional to Total Dissolved Solids concentration
Bedrock
Coyote
Llagas Confined
Llagas Unconfined
N
5 0 5 10 Miles
Santa Clara Valley Water District

Figure 5-3


Extent of Saltwater Intrusion in Upper Aquifer Zone
N
101
237
85
880
100 mg/L Chloride Contour
Upper Aquifer Zone Wells
Salt Evaporation Ponds
San Francisco Bay
Santa Clara Valley Confined
Santa Clara Valley Unconfined
Santa Clara Valley Water District
5
0
5 Miles
Figure 5-4


Nitrate Concentrations in Principal Aquifer Zone
N
Nitrate Concentration
Nondetectable
1 - 24 mg/L
24 - 45 mg/L
> 45 mg/L
Bedrock
Coyote
Llagas Confined
Llagas Unconfined
San Francisco Bay
Santa Clara County
Santa Clara Valley Confined
Santa Clara Valley Unconfined
Santa Clara Valley Water District
10 0 10 20 Miles
Figure 5-5

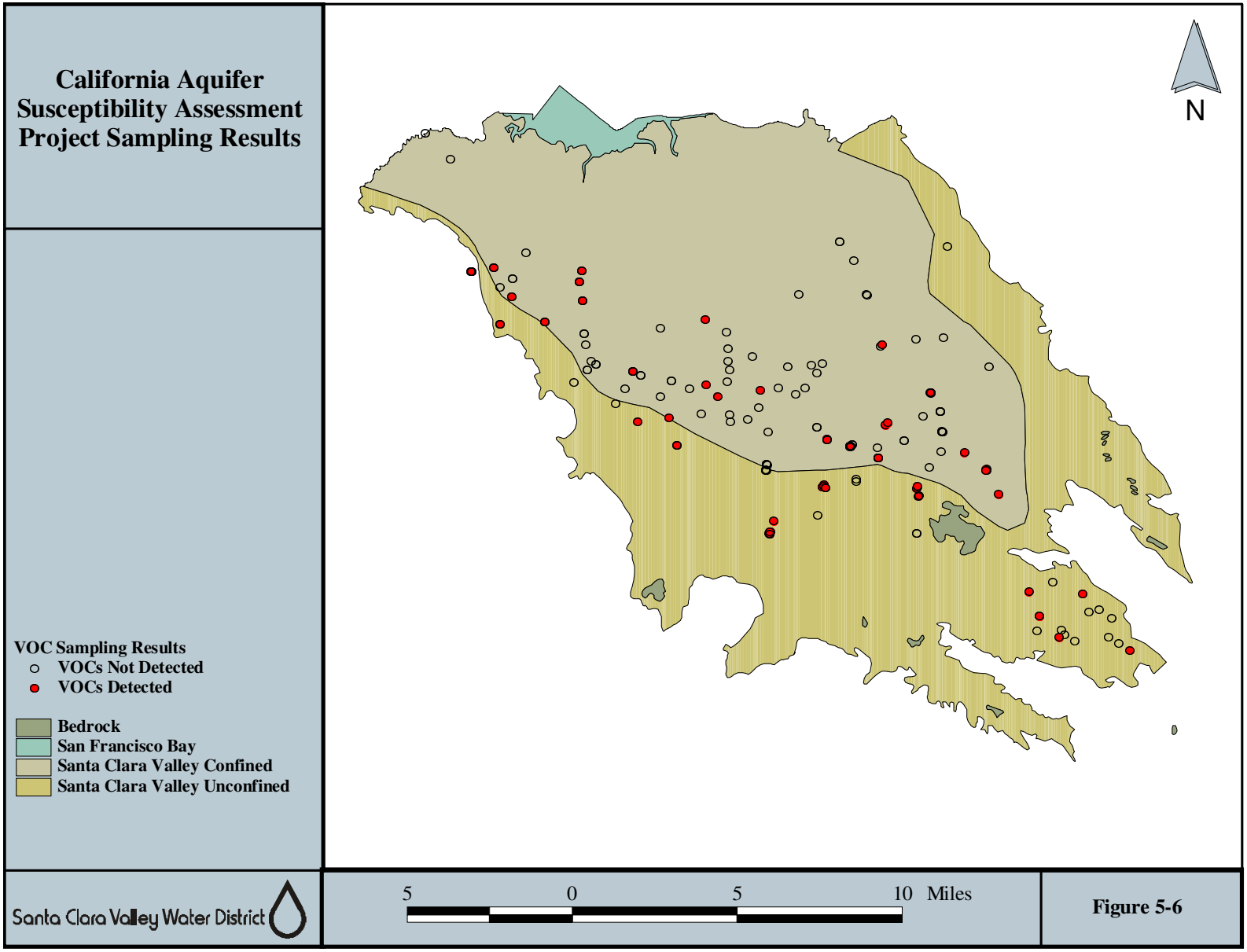
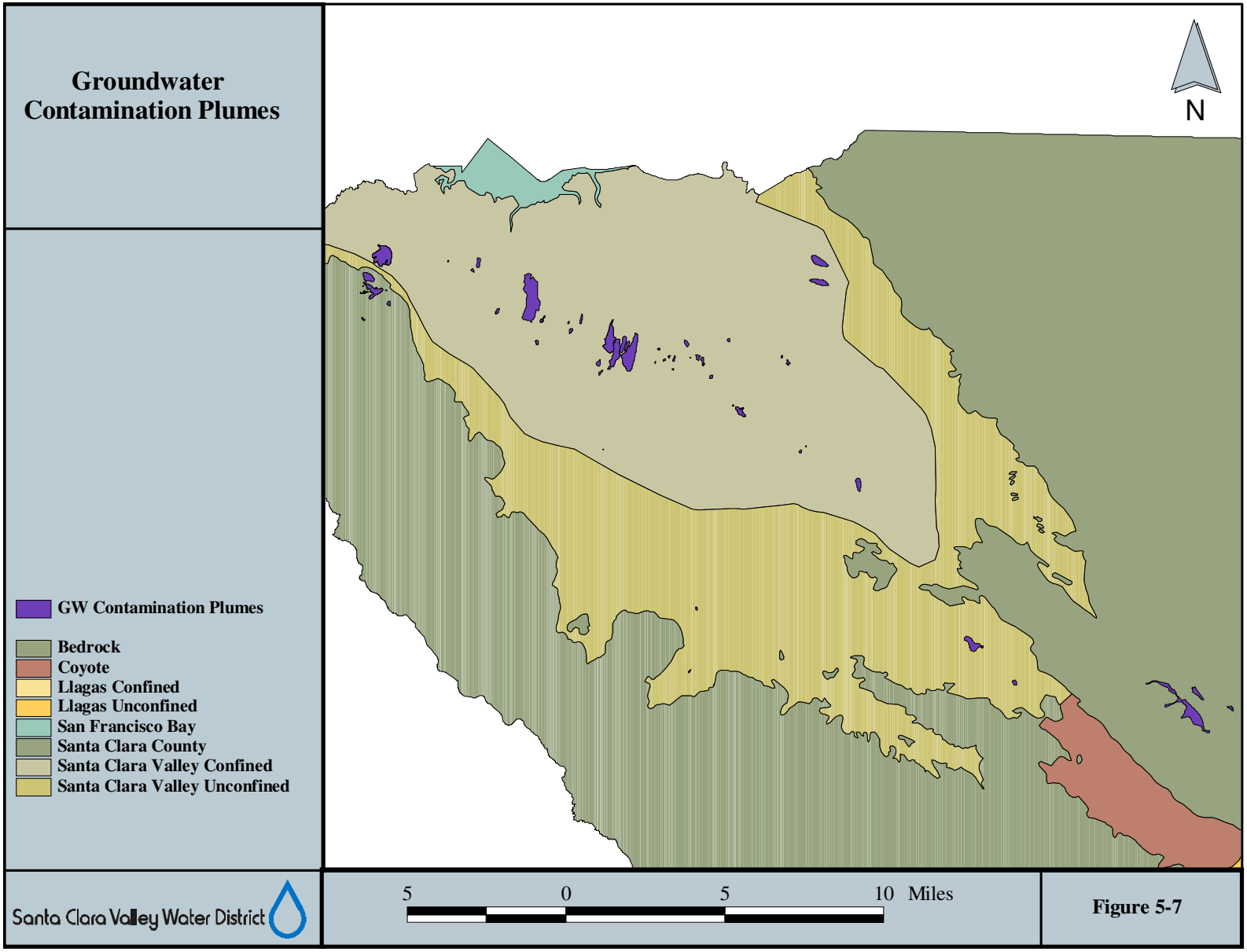

California Aquifer Susceptibility Assessment Project Sampling Results
VOC Sampling Results
VOCs Not Detected
VOCs Detected
Bedrock
San Francisco Bay
Santa Clara Valley Confined
Santa Clara Valley Unconfined
N
5 0 5 10 Miles
Santa Clara Valley Water District

Figure 5-6


Groundwater
Contamination Plumes
N
GW Contamination Plumes
Bedrock
Coyote
Llagas Confined
Llagas Unconfined
San Francisco Bay
Santa Clara County
Santa Clara Valley Confined
Santa Clara Valley Unconfined
Santa Clara Valley Water District
5
0
5
10 Miles
Figure 5-7

6.0 Related Groundwater Projects

6.1 Improving the Groundwater Monitoring Network

6.1.1 Depth-Discrete Monitoring Wells

The District is updating the existing Groundwater Elevation Monitoring Network to target monitoring wells where discrete, depth-specific groundwater elevations can be obtained. In the Santa Clara Valley Subbasin, 15 aquifer-specific wells from other organizations have been successfully transferred to District ownership. The District also installed a depth-discrete monitoring well in the Coyote Narrows in 2001 (Figure 6-1).

In June 2000, the District Board of Directors approved a four-year cooperative study with the USGS to complete seven multiple-well monitoring sites in the Santa Clara Valley Subbasin. Each site will contain a borehole approximately 1,000 feet deep containing four nested piezometers, and a separate shallow well. Once constructed, these wells will allow the District to obtain depth-specific groundwater elevation and quality data at strategic locations throughout the subbasin. Four sites have already been completed (Figure 6-1), at the Coyote Creek Outdoor Classroom site (October 2000), in Willow Glen (April 2001), at the McGlincey Ponds (August 2001) and near Santana Park in San Jose (April 2002). Groundwater elevation data from the depth-specific wells will be collected on a monthly basis, and a comprehensive suite of groundwater quality data will be obtained annually. The remaining three sites to be drilled in the Santa Clara Valley Subbasin under the cooperative agreement with the USGS are scheduled to be completed by 2004.

Although four multiple-well monitoring sites (total of 21 wells) have been completed through the USGS project, only the Coyote Creek Outdoor Classroom (CCOC) site has groundwater elevations recorded for all of 2001. An idealized lithologic log and construction diagram for CCOC is shown in Figure 6-2. The lithologic log shows that local materials are primarily sandy gravels with relatively thin layers of lower permeability sandy silty clays. The CCOC hydrograph is shown in Figure 6-3. The wells are numbered CCOC-1 through 5; the well number increases as you near land surface, with CCOC-1 being the deepest well and CCOC-5 indicating the separate shallow well. For the five wells drilled at the site, the hydrograph shows three distinct potentiometric surfaces, indicating three unique water-bearing zones.

6.1.2 Monitoring Network Integration

The District is currently developing a work plan for the integration of the general groundwater elevation and groundwater quality programs into a single comprehensive network. District staff will evaluate the current general groundwater quality and groundwater elevation networks to determine areas of overlap between programs, and to identify significant data gaps in either individual network that could be addressed through integration. District staff will review geologic and hydrogeologic data in addition to data from existing wells to determine which depth zones need better representation. A monitoring network report for South County will be completed by December 2003, and a summary of the review of the North County network will be developed upon completion of that analysis.

6.2 Improving Groundwater Modeling

The District is currently working to upgrade the existing Santa Clara Valley Subbasin groundwater flow model to simulate wells pumping from multiple aquifers, land subsidence, faults as horizontal flow barriers, and streamflow routing. These upgrades will allow for improved simulation of the North County, and will increase the usefulness of the model as a tool for groundwater management in that

region. The District is also planning to begin development of a groundwater flow model for the Coyote and Llagas Subbasins in 2003.

To improve future groundwater modeling efforts, the District is working with the USGS to develop a three-dimensional relational database containing geologic, geophysical, geochemical, and hydrologic data throughout the county. This database, and the related visual model are expected to yield valuable insight into the structure and stratigraphy of the groundwater basin. This will result in improvements to the District's conceptual model of the basin and to future groundwater modeling efforts.

6.3 Forecasting Groundwater Conditions for 2002

To forecast groundwater conditions in the Santa Clara Valley Subbasin for the 2002 calendar year, the District used the North County groundwater model (MODFLOW based) with various assumptions for rainfall and water use. Two different rainfall assumptions were used, based on 50 percent and 90 percent exceedence levels. A 90 percent exceedence level means that there is a 90 percent chance that rainfall amounts will exceed this level, therefore it represents a drought condition, or conservative approach. The 2002 water use assumptions were developed as part of the Integrated Water Resources Plan (IWRP) process. Other assumptions used in the modeling vary based on the rainfall assumptions. They include the amount of water treated by District facilities, the amount of Hetch Hetchy water deliveries, and the amount of water provided by both San Jose Water Company and Stanford. Agricultural uses and recharge due to sewer system leaks were also included, but these have a minimal effect on the subbasin as they do not vary significantly.

The 50 percent exceedence level is equivalent to assuming an average rainfall year. Using this hydrologic assumption, enough local and imported water will be available and groundwater pumping in the Santa Clara Valley Subbasins is predicted to be at normal levels of about 111,000 acre-feet in 2002. This hydrology will allow for a full groundwater recharge program and for reservoir carryover at the end of the year that exceeds the minimum/emergency pool levels.

The 90 percent exceedence level represents a drought condition, or the worst-case scenario. Under this hydrology, total water use in the North County is projected to be 334,000 acre-feet, and increase of approximately 2,000 acre-feet from the 90 percent exceedence value of 2001. Hetch Hetchy deliveries would be decreased from an estimated 62,481 acre-feet to 58,011 acre-feet. Reservoir carryover at the end of this year would be limited to the minimum/emergency pool levels at all of the reservoirs but Anderson. Due to decreases in surface water availability under this scenario, groundwater pumping would increase to 125,000 acre-feet. Assuming this hydrologic condition, there would still be sufficient imported and local surface water to meet the treated water demand of about 140,000 acre-feet, but there would not be sufficient surface water to conduct a full recharge program. Thus, the 90 percent exceedence condition results in lowered groundwater levels due to increased pumping and decreased recharge.

The results of this analysis show that even under the drought-condition rainfall scenario, the Santa Clara Valley Subbasin should be able to meet demands in 2002 without substantial adverse effects, such as land subsidence. This assessment is based on the results of modeling the various operational scenarios described above and the fact that groundwater elevations in the Santa Clara Valley Subbasin were at or near historically high levels in early 2002.

6.4 Groundwater Management Plan Update

District staff are working to complete an updated Integrated Water Resources Plan (IWRP) in 2002. The IWRP is the District's long-term water supply plan for the county through year 2040. The objective of the IWRP is to develop a long-term, flexible, comprehensive water supply plan that incorporates

community input and can respond to changing water supply and demand conditions. The IWRP will investigate whether operating the groundwater basin differently will increase water supply reliability.

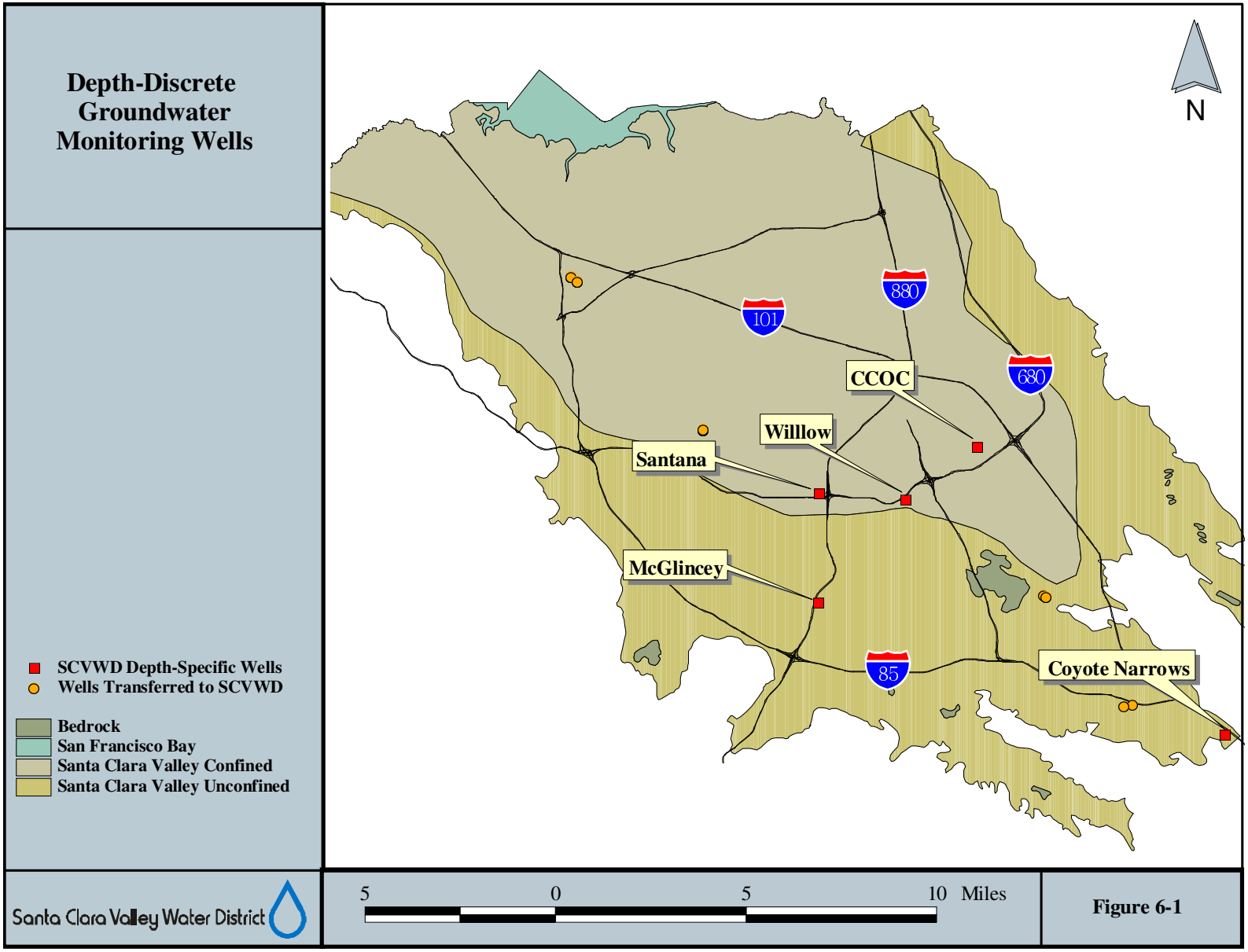
Related to the IWRP process, the District is also working to develop an update to the Groundwater Management Plan that was completed in July 2001. The Groundwater Management Plan update is scheduled for completion in late 2002 and will focus on the following groundwater management strategies:

- Manage the basin to meet demands and minimize negative impacts –
  This strategy will focus on maximizing water supply from the basin while ensuring that negative impacts such as land subsidence are minimized. This effort will be based on the results of the 2002 IWRP update in terms of how the IWRP defines the role of the groundwater basin in the context of the overall water supply. This strategy will address how much can be pumped from the basin and how much should be recharged under various hydrological and demand scenarios.

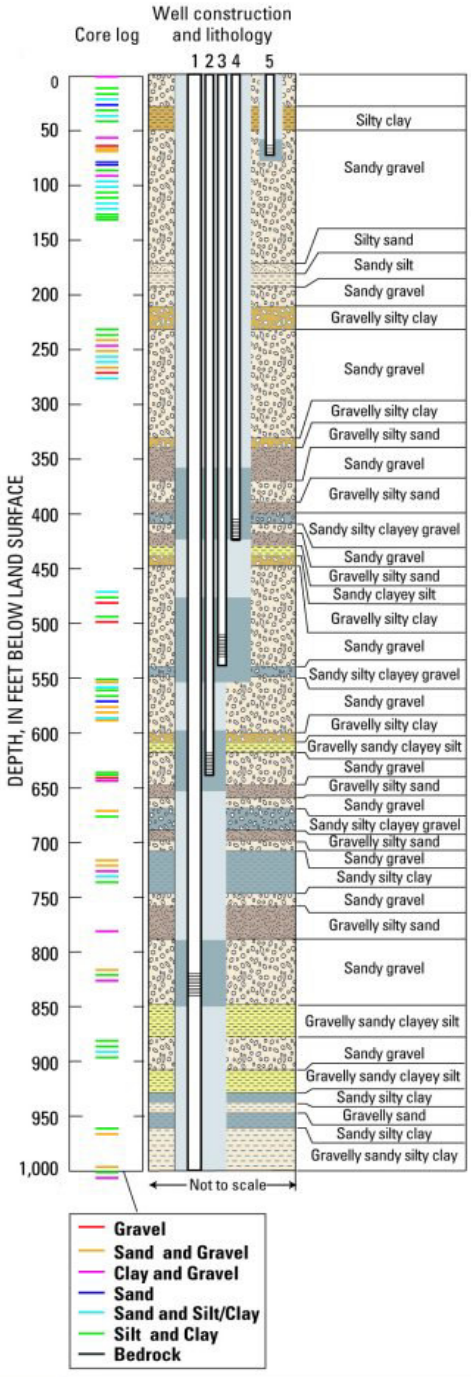
- Protect the basin from contamination and the threat of contamination –
  This strategy will be designed to protect the basin from groundwater quality degradation and to protect water quality for beneficial uses. The strategy will identify sensitive areas of the groundwater basin, evaluate potential sources of contamination, assess the extent and severity of existing groundwater contamination problems, and prevent and manage contamination. Specific activities will include developing an infiltration standard, performing public outreach, conducting special studies, and continuing existing programs for preventing contamination.

- Continue to improve our understanding of the groundwater basin –
  A strategy will be developed to ensure that our modeling and monitoring efforts are effective at answering the pertinent "big picture" questions. This will include plans to better define the conceptual model of the basin and to integrate groundwater elevation and groundwater quality networks.

- Effectively coordinate and communicate with internal and external agencies –
  This strategy will focus on improving coordination both internally and externally. The internal plans will focus on District staff from various units involved with groundwater and will outline plans to increase the sharing of ideas, knowledge, and technical expertise while reducing duplication of work efforts. External coordination will focus on local water retailers and state and federal agencies.


Depth-Discrete Groundwater Monitoring Wells
SCVWD Depth-Specific Wells
Wells Transferred to SCVWD
Bedrock
San Francisco Bay
Santa Clara Valley Confined
Santa Clara Valley Unconfined
N
101
880
680
85
CCOC
Willlow
Santana
McGlincey
Coyote Narrows
Santa Clara Valley Water District
5 0 5 10 Miles
Figure 6-1

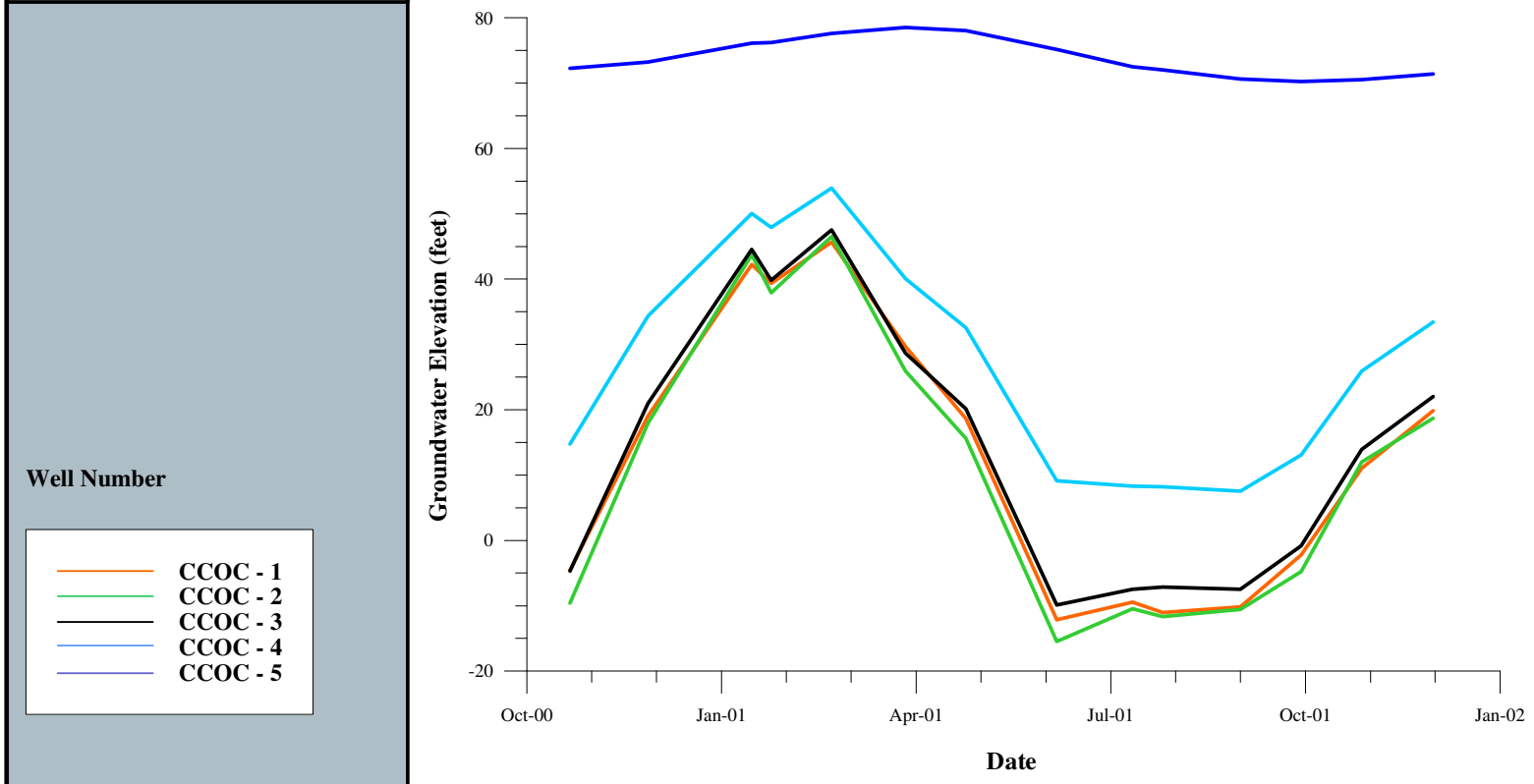
CCOC Idealized Well Construction and Lithologic Log (Preliminary)



Santa Clara Valley Water District

Figure 6-2

Coyote Creek Outdoor Classroom (CCOC) Depth-Specific Groundwater Elevations



Santa Clara Valley Water District

Figure 6-3

7.0 New Groundwater Legislation and Regulations

7.1 Groundwater Legislation

The California Legislature passed several bills related to groundwater in 2001. The bills that could have an impact on the District are summarized below.

AB 254 (Frommer) Brownfields Loans: CLEAN Program

This bill made technical changes to California Environmental Protection Agency's Cleanup Loans and Environmental Assistance to Neighborhoods (CLEAN) Program that will allow a broader array of potential recipients to be eligible for cleanup loans. The District would be eligible for some funding on certain properties, but the funding would be for services we already provide. Therefore, this bill will have a minimal impact on the District.

AB 378 (Calderon) Water Quality: Cleanup

This bill clarifies, in statute, that the Regional Water Quality Control Boards (RWQCBs) are required to consult with the District, affected water suppliers, and the California Department of Health Services when determining applicable water quality standards to be achieved by groundwater cleanup systems that pump from water supply aquifers and discharge to either surface water or groundwater from which a public water system draws drinking water. The bill also increases the opportunities for RWQCBs to contract with water districts to provide investigation, cleanup, and abatement of contaminated or potentially contaminated sites. This bill benefits the District by providing opportunities to influence groundwater cleanup systems whose discharges could affect groundwater quality.

AB 599 (Liu) Groundwater Contamination: Quality Monitoring Program

This bill requires the State Water Resources Control Board (SWRCB) to integrate existing groundwater monitoring programs and design new program elements, as necessary, for the purpose of establishing a comprehensive monitoring program capable of assessing each groundwater basin in the state, to create an interagency task force to identify actions necessary to establish the monitoring program, and to identify measures that would increase coordination among state and federal agencies that collect groundwater contamination information. The SWRCB, in consultation with other specified agencies, shall submit to the Governor and the Legislature, on or before March 1, 2003, a report that includes a description of a comprehensive groundwater quality monitoring program for the state. This effort could result in improved coordination between agencies, data management, and access to data. All of these outcomes would benefit the District.

SB 351 (Ortiz) Public Health: Drinking Water: Hexavalent Chromium Standard

This bill requires the California Department of Health Services (DHS) to adopt a primary drinking water standard for hexavalent chromium. The standard must be adopted by January 1, 2004, and a report on the progress of developing the standard must be provided to the Legislature by January 1, 2003. Hexavalent chromium is the toxic part of total chromium. The District and retailers comply with the California primary drinking water standards for total chromium and expect they will also comply with the hexavalent chromium standard.

SB 463 (Perata) Drinking Water Standards: Arsenic

This bill requires DHS to commence the process of revising the existing primary drinking water standard for arsenic of 50 micrograms per liter (ug/L) and to adopt a revised standard for arsenic no later than June 30, 2004. The revised standard will be 10 ug/L or less, in order for California to comply with the federal drinking water standard of 10 ug/L adopted in January 2001. Some areas of the groundwater basin have detectable concentrations of arsenic. The impact of this bill on this District and retailers will be minimal if California adopts the federal 10 ug/L standard. However, if California adopts a lower standard, this bill could result in significant costs for some public water supply well owners.

SB 610 (Costa) Water Supply Planning

This bill requires additional information on groundwater to be included as part of the urban water management plan if groundwater is identified as a source of water available to the supplier. The bill would require an urban water supplier, such as the District or a water retailer, to include in the plan a description of all water supply projects and programs that may be undertaken to meet total projected water use. The bill would prohibit an urban water supplier that fails to prepare or submit the plan to the department from receiving funding from specified bond acts and drought assistance until the plan is submitted.

The bill requires a city or county that determines a project is subject to the California Environmental Quality Act to identify any public water system that may supply water for the project and to request those public water systems prepare a water supply assessment, except as otherwise specified. The assessment shall include an identification of existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project and water received in prior years pursuant to those entitlements, rights, and contracts. The bill requires the city or county, if it is not able to identify any public water system that may supply water for the project, to prepare the water supply assessment after a prescribed consultation.

The bill prescribes a timeframe within which a public water system is required to submit the assessment to the city or county and would authorize the city or county to seek a writ of mandamus to compel the public water system to comply with requirements relating to the submission of the assessment. The bill would require the public water system, or the city or county, as applicable, to submit the plans for acquiring additional water supplies if that entity concludes that water supplies are, or will be, insufficient.

This law could result in significant use of staff time to respond to city and county requests for water supply assessments and information on groundwater conditions.

7.2 New Regulations

7.2.1 Arsenic

The U.S. Environmental Protection Agency revised the federal drinking water standard for arsenic in January 2001. The regulation lowers the federal arsenic drinking water standard from 50 ug/L to 10 ug/L. The compliance date for meeting the 10 ug/L standard is January 23, 2006. Staff does not anticipate that local public water suppliers will have difficulty complying with the revised federal drinking water standard for arsenic. However, there may be compliance problems if California adopts a lower arsenic drinking water standard. Arsenic is detected in some areas of the Santa Clara County groundwater subbasins.

7.2.2 Consumer Confidence Reports

DHS adopted regulations requiring annual consumer confidence reports (CCRs) in January 2001. In 1996, Congress amended the Safe Drinking Water Act, adding a requirement that water systems deliver to their customers a brief annual water quality report, similar to the Annual Water Quality Report (AWQR) that California utilities have been distributing since 1990. However, the new CCR regulatory requirements are more specific and detailed in terms of content and format than those for the AWQR.

The rationale for CCRs is that consumers have the right to know what is in their drinking water and where that water comes from. The reports help consumers to make informed choices that affect their health and the health of their families. They also encourage consumers to consider the challenges of delivering safe drinking water. Educated consumers are more likely to help protect their drinking water sources and to understand the true costs of safe drinking water (DHS, 2002).

The District is not required to prepare CCRs, but is required to provide water quality data to water retailers who receive water from any of our three drinking water treatment plants.

7.2.3 Unregulated Chemicals Requiring Monitoring

DHS adopted a regulation requiring monitoring of unregulated chemicals in January 2001. Unregulated chemicals requiring monitoring are chemicals that lack a drinking water standard, but must be monitored by public water suppliers according to regulation. Table 7-1 lists the unregulated chemicals for which monitoring is required, along with preliminary detection levels for purposes of reporting (DLRs) and, where appropriate, the chemical's drinking water advisory action level.

The District continues to review the groundwater monitoring data collected by the retailers to identify potential and existing water quality problems. When problems are identified, staff works with water retailers and other agencies to implement appropriate corrective action.

The state and/or federal government are preparing or finalizing regulations on the following topics: groundwater recharge with recycled water, radionuclides, arsenic, hexavalent chromium, groundwater disinfection, and miscellaneous drinking water standard revisions. Most of these regulations apply to public water suppliers and do not directly impact the District. However, the District works to aggressively protect the groundwater basin from contamination and the threat of contamination, in accordance with Board Ends Policy 2.1.5, and to minimize the need for wellhead treatment.

The future regulation that will most directly impact the District is the DHS regulation for groundwater recharge with recycled water. Expanding the use of recycled water and protecting groundwater are both District Ends Policies. The District is tracking the status of this regulation and providing input to ensure

that it is sufficiently protective of high quality groundwater and provides the District with sufficient authority to protect our local groundwater basin when recycling projects are proposed.

Table 7-1
Unregulated Chemicals Requiring Monitoring

Chemical	Detection Limit for Reporting (mg/L)	Action Level (mg/L)
Inorganics		
Boron	0.1	1
Hexavalent chromium	0.001	—
Perchlorate	0.004	0.004
Vanadium	0.003	0.05
Organics		
Dichlorodifluoromethane (Freon 12)	0.0005	1
Ethyl tertiary butyl ether (ETBE)	0.003	—
Tertiary amyl methyl ether (TAME)	0.003	—
Tertiary butyl alchohol	0.002	0.012
1,2,3-Trichloropropane (1,2,3-TCP)	0.000005	0.000005

8.0 Summary

Groundwater is an essential component of the overall water supply for Santa Clara County, supplying nearly half of the total water used. As such, protection of groundwater resources is vital to the growth and prosperity of the county. The District's numerous groundwater management programs demonstrate that the District is proactive and vigilant in terms of sustaining and protecting the county's groundwater resources.

This purpose of this 2001 Groundwater Conditions Report was to describe and document conditions within the county's three groundwater subbasins for calendar year 2001. Results from District programs to monitor groundwater elevation, land subsidence, and groundwater quality are summarized below.

8.1 Groundwater Use and Recharge

Approximately 169,300 acre-feet of groundwater was extracted for beneficial use in 2001; this accounts for 44 percent of the total 382,500 acre-feet of water used in Santa Clara County. Approximately 115,400 acre-feet of groundwater was withdrawn from the Santa Clara Valley Subbasin; this includes approximately 114,600 acre-feet for municipal and industrial (M&I) uses, with less than 800 acre-feet used for agriculture. Approximately 53,900 acre-feet of groundwater was extracted from the Coyote and Llagas Subbasins in 2001; with approximately 25,400 acre-feet used for M&I uses and 28,500 acre-feet for agriculture.

Through artificial recharge operations, approximately 129,100 acre-feet of water recharged the groundwater subbasins through in-stream and off-stream recharge facilities in 2001. Approximately 90,700 acre-feet of water recharged the Santa Clara Valley Subbasin through artificial recharge; this includes 40,700 acre-feet through off-stream ponds and 50,000 acre-feet through the in-stream recharge program. Approximately 38,400 acre-feet of water recharged the Coyote and Llagas Subbasins through artificial recharge, including 8,500 acre-feet through off-stream ponds and 29,900 acre-feet through in-stream recharge.

Groundwater withdrawals and natural and artificial replenishment resulted in the following net change in storage. Storage in the Santa Clara Valley Subbasin increased by approximately 12,500 acre-feet in 2001. In South County, there was a net decrease in the storage of the Coyote and Llagas Subbasins, of approximately 300 acre-feet and 21,000 acre-feet, respectively.

8.2 Groundwater Elevation Monitoring Summary

In general, groundwater elevations throughout the county were quite high in 2001, due to a near-normal rainfall year and active groundwater recharge. Current groundwater elevations in the Santa Clara Valley Subbasin index well are approximately 20 feet below the historic maximum levels and are over 200 feet above the minimum groundwater levels recorded since 1915. Additionally, the minimum 2001 groundwater elevation recorded in the fall is approximately 70 feet above the subsidence threshold, which is one of the District's performance measures to ensure "Groundwater supplies are sustained" in accordance with Board Ends Policy. While groundwater elevations in the Llagas Subbasin index well remain above the performance measure target elevation, groundwater elevations have been declining for the last several years. Overall, 2001 data indicate that the District is exceeding the performance measures established to ensure "Groundwater supplies are sustained."

8.3 Land Subsidence Monitoring Summary

As a result of significant historical land subsidence in the North County, the District monitors land subsidence throughout the Santa Clara Valley Subbasin. Monitoring at two extensometers, eight subsidence index wells, and 147 benchmarks in 2001 indicates that any residual subsidence that is occurring is within the tolerable range established by the District. Monitoring at benchmark P7 indicates that the District exceeds the related performance measure designed to ensure "Groundwater supplies are sustained." In general, monitoring data from 2001 indicates that land subsidence in the Santa Clara Valley Subbasin is minimized by the District's proactive groundwater management activities.

8.4 Groundwater Quality Monitoring Summary

Overall groundwater quality in Santa Clara County is very good and water quality objectives were achieved in almost all wells. The most significant exception is nitrate, which continues to be a concern in the Llagas and Coyote Subbasins. The nitrate drinking water standard was exceeded in 40 wells. Some of these are upper zone monitoring wells and others are agricultural supply wells. However, the drinking water standard for nitrate was exceeded in 22 wells whose primary use is municipal or domestic supply, necessitating blending or treatment prior to delivery to customers. The District is continuing to implement a comprehensive nitrate management program to reduce nitrate exposure, reduce nitrate loading, and monitor groundwater quality.

Drinking water standards for other inorganic constituents were exceeded in 20 wells. However, all these exceedences were for naturally occurring constituents, and all but one of the exceedences was for a secondary drinking water standard. Secondary standards are based on protecting consumers from adverse tastes, odors, or appearance and such exceedences do not pose a health risk. One well contained fluoride concentrations in excess of the primary, or health-based, drinking water standard.

The agricultural objective for boron was exceeded in 15 wells, but none of those wells is used for agricultural supply.

MTBE was detected just above the secondary drinking water standard of 5 ug/L in two monitoring wells. These wells were in the upper aquifer zone, rather than the deeper, primary water supply aquifer. There were no detections of MTBE above the primary drinking water standard.

The drinking water standard for gross alpha particle activity, an indicator of natural radioactivity, was exceeded in one well. However, the average measurement, on which compliance is based, was well below the standard.

District Board Ends Policy directs staff to ensure "The groundwater basins are aggressively protected from contamination and the threat of contamination." The Chief Executive Officer's interpretation of this policy is that drinking water standards for anthropogenic constituents should not be exceeded in water supply wells. The data summarized in this report shows that, for the most part, groundwater management programs achieve the desired end. The nitrate standard was the only drinking water standard for an anthropogenic constituent that was exceeded in drinking water supply wells and it was exceeded in a very small percentage of wells. The District continues to implement a comprehensive nitrate management program to monitor nitrate occurrence, reduce consumer exposure to nitrate in drinking water, and reduce nitrate loading throughout the basin. The goal of the nitrate management program is to reduce nitrate concentrations in groundwater so that all wells meet the drinking water standard for nitrate.

The District will continue monitoring groundwater quality and collecting public water supply well data from DHS.

8.5 Future Work

The District will continue to summarize the annual results of groundwater elevation, groundwater quality, and land subsidence monitoring programs in future Groundwater Conditions reports. The results of the District's groundwater monitoring programs are used to evaluate current groundwater conditions, to optimize recharge efforts, to assess groundwater storage and groundwater quality, and to support modeling efforts. Rigorous groundwater monitoring and analysis of that data is critical to ensuring the long-term viability of groundwater as part of the county's water supply.

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